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TO THE

Cement and Engineering News

Vol. 24. January—December, 1912

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CEMENT
... AND ...
ENGINEERING NEWS

FOUNTAIN—HOUSE OF TRACY DOWS, ESQ.

Rhinebeck, N. Y. Henry Hering, Sculptor.
(From Architectural Record.)

CEMENT AND ENGINEERING NEWS

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CHICAGO, JANUARY, 1912.

BUSINESS OUTLOOK.

During the past year the cement industry, as a whole, like all other branches of business, had to suffer from too much destructive instead of constructive legislation. The result of it was that mills located in the East and middle West offered, at the year's end, cement in car lots at manufacturing cost or at figures very near it, and that only the best managed plants earned fair dividends.

Nineteen hundred and twelve promises to be better from many points of view. Not that confidence has been definitely restored, but the building world, which has been at a standstill for practically a year, has to resume operations and to do a certain amount of work which has been neglected pending numerous Supreme court decisions. The revival of the steel business and the orders of the large railroad companies, which are the best trade barometer throughout the country, augur well for the cement business in 1912, although too much must not be expected of any industry in a year when the country has to pass through the throes of a presidential election.

The fast developing Pacific Coast states is the only location left in this country where fortunes can still be made in manufacturing cement; everywhere else the business has been practically overdone. Suitable raw materials seem to be scarce on the Pacific Coast, as the experience of some of the largest eastern cement manufacturers indicates, many of whom have kept up a vain search for cement materials for years and have paid fabulous prices for raw material deposits, even if they could be proven to be merely of the most common grade. Therefore, most western cement propositions, if compared with those in the East, are much inferior as far as location of raw materials, their unformity and accessibility is concerned. Those that are first class propositions have been acquired for sums large enough to build a good-sized cement plant.

VALUABLE CEMENT RAW MATERIALS IN OREGON.

Up to a short time ago the state of Oregon was declared to be one of the few states of the Union in which raw materials suitable for the manufacture of Portland cement were rather scarce or could not be found at all.

In California and Washington a number of cement plants were erected during the past eight years with a view to lowering the cost of cement which was, prior to that time, exclusively imported from Europe and commanded a price of from $3.00 to $4.00 per barrel. These western plants, as the first in the field, have been extremely successful, although most of them had to contend with irregular raw materials and some of them had to haul their limestone and shale a distance of twenty or thirty miles.

In Oregon, however, for a long time capitalists tried in vain to locate cement raw material deposits which might be called satisfactory. In spite of this, several years ago a cement company was organized with headquarters at Portland, Oregon, which expected to manufacture cement at a town in the vicinity of Portland and to compete with California and Washington plants. But, unfortunately, they have to haul their limestone a distance of 200 miles and their shale from a place 80 miles from the plant, which will soon be found to offset the advantage of location over the plants in the neighboring states.

Thus, it was considered in Oregon an utter impossibility to find both raw materials—limestone and shale—in the same locality; otherwise no company could have possibly been formed which would have to face such difficulties in the way of hauling their raw materials as the Portland cement company referred to in the foregoing.

Contrary to all expectations the long search for high grade cement materials in Oregon has at last been crowned by success, so that this state will be named in the future among those possessing the most uniform and most remarkable cement deposits in the country.

The location of these newly discovered deposits is the Riedle property near Roseburg, Oregon, a horseshoe shaped range of mountains rising 500 feet above level land. The raw materials, an abundance of limestone of the highest grade, almost pure marble, and shale of absolutely uniform composition, are located on the north and south side of the property at an altitude of several hundred feet in such a position that they would be about 100 feet above the crushers of a cement plant built on one of the hillsides and that the limestone would be within 500 feet and the shale within 1,500 feet of the crushers. Moreover, the composition of these materials is so remarkably uniform that they have to be mixed at all times to come in the proportion of 400 parts of limestone to 100 parts of shale, which is an advantage enjoyed by only very few cement plants in the country, most of which have to change the composition of the raw materials every day or week, and which insures the manufacture of a safe and always reliable product.

Dr. W. Michaelis of Chicago, who thoroughly examined these properties and burnt Portland cement from the limestone and shale occurring on the Riedle property, declared these deposits to contain the most uniform and valuable cement materials west of Devil's Slide, Utah, a statement of some meaning, as during the past eight years Dr. Michaelis has been called upon to expert and report upon the most important cement propositions in Utah, Idaho, Washington and Oregon, and consequently must be considered an authority on cement deposits in those western states.

Experiments in Paving

By Edward M. Hagar

During the past few years a distinctly new type of pavement, consisting of a properly constructed concrete base and a thin wearing surface of bitumen and sand, has been developed and extensively used on the main streets at Ann Arbor, Michigan, and to a somewhat more limited extent in other cities and towns.

About four years ago in order to prolong the life of the asphalt block pavements, which at that time showed considerable wear, E. W. Graves, city engineer, Ann Arbor, as an experiment, tried covering the surface of the pavement with a thin coating of coal tar and sand. After being subjected to various conditions of traffic for two years this thin wearing surface proved to be so satisfactory that Mr. Graves determined to try it for new construction work on a concrete base. During the summer of 1909 one block on a residence street was paved with concrete, having a coal tar and sand wearing surface. In 1910 approximately 18,000 square yards of this pavement were laid, the same type of construction having been adopted for an additional 63,000 square yards on nine main streets and alleys. This year there will be laid in the neighborhood of 100,000 square yards, petitions having been received for a greater yardage than can be constructed.

Method of Construction at Ann Arbor.

Ann Arbor has a well-drained, somewhat sandy subsoil, and the concrete pavement is laid directly upon the sub-grade without using a sub-base, which would be necessary where a heavy, wet, poorly drained subsoil is encountered. The concrete pavement proper consists of a 4½-inch gravel concrete base and a 1½-inch wearing surface, mixed one part cement to two parts clean, coarse sand. The concrete is laid in strips one-half the width of the street wide, and 25 feet long, an expansion joint from three-quarters of an inch to one inch in width being placed every 25 feet across the street, perpendicular to the axis and at each curb.

The surface of the concrete is given a wood-float finish and slightly roughened by brushing with an ordinary hand street broom. After finishing a section as described the form at the center or crown of the street is removed, and the pavement for the other half of the street laid, the new concrete being deposited against that which has been previously placed, so that while there is a joint at the crown of the street it is hardly perceptible. This joint would be decidedly objectionable were it not protected by the wearing surface of bitumen and sand that is later applied, and even with this type of construction we believe should be eliminated by laying the pavement in sections extending across the full width of the street. This is possible and has been successfully done where concrete pavements have been laid on streets wider than those at Ann Arbor.

After the concrete has hardened the surface is covered with hot bitumen applied with a sprinkler wagon designed for the purpose, having a firebox under the tank to heat the material. The bitumen is immediately distributed evenly over the surface of the concrete by brushing with an ordinary street-sweeper broom, and the surface then covered with sand. Approximately one-half gallon of bitumen is applied per square yard of surface, and a cubic yard of sand will cover about 230 square yards, making the wearing surface from one-quarter to three-eighths of an inch in thickness. For the first pavement laid Mr. Graves used ordinary coal tar, obtained from the local gas works. Later on he tried distilled tar, and considered that this was more satisfactory than the crude tar. This year he has used "Tarvia," has experimented with asphalt, and is now using a specially prepared bitumen known as "Dolarway."

The Cost.

The work at Ann Arbor is done by the city, which has its own equipment, purchases material and hires the labor. In 1910, with common labor at $1.75 to $2.00 per day, cement from $1.07 to $1.32 per barrel, and gravel at 75 cents per cubic yard on the street, the cost of a 6-inch concrete pavement and wearing surface of bitumen and sand has varied from 71 cents to 80 cents per square yard; the total cost, including light grading and a 6x8x14-inch curb on each side of the street, varied from 94 cents to $1.16 per square yard of pavement on streets 30 and 34 feet wide. With "Tarvia" at 8 cents per gallon and sand at 75 cents per cubic yard, the cost of materials and labor for the wearing surface has been approximately 5 cents per square yard. These figures are for the actual cost of construction with materials and labor as given.

Objections to Ordinary Concrete Pavements.

The ordinary concrete pavement without a wearing surface of bitumen and sand has been extensively used on city streets and public highways throughout the country, and where properly constructed with suitable materials has given splendid satisfaction. Such a pavement is, however, not as noiseless or as resilient as asphalt, bitulithic macadam or wood block, and in addition to the noise there is occasionally some objection to the appearance of and the glare from such a pavement. Some difficulty has also been experienced in preventing wear and chipping at the expansion joints, and the formation of cracks in the surface. By covering the concrete with a thin though durable wearing surface these objections may be eliminated, and at a cost of not to exceed 10 cents per square yard of surface. The appearance of the pavement is changed; it becomes noiseless and much more resilient. The wearing surface takes the wear, protects the expansion joints and hides unsightly, though otherwise unobjectionable cracks should they occur.

Materials.

The materials required for the construction of this pavement are to be found or easily obtained in all localities, and the equipment necessary, besides the usual tools owned by every contractor, consists simply of a suitable concrete mixer, a tank wagon for sprinkling bitumen, an ordinary street sweeper and a wagon provided with a sand spreader.

Requirements of Good Construction.

First-class construction for this type of pavement we consider should consist of 6-inch concrete base mixed with one part cement to two parts clean, coarse sand, and three or four parts (depending upon the size and quality) of crushed stone or screened gravel laid upon a properly compacted sub-grade where a porous, well-drained sub-soil is encountered, or upon a properly prepared sub-base upon a heavy, wet, poorly drained clay soil. In some cases it will also be necessary to lay tile drains provided with suitable outlets.

The concrete should be laid in strips the full width of the street wide, and about 25 feet long, and should be given a wood-float finish and slightly roughened by

brushing with an ordinary street broom. A 3/8-inch expansion joint should be left every 25 feet across the street perpendicular to the axis and at the curb, the expansion joint to be filled with bitumen. After the concrete has hardened it should be sprinkled with one-half gallon per square yard of hot bitumen, which should be immediately covered with clean, coarse sand or suitable stone screenings.

The concrete pavements at Ann Arbor have been subjected for the past two years to all conditions of traffic of a city of 15,000. Kansas City has a small stretch of similar pavement on Sixth street, which has been exposed since last fall to the heaviest traffic in the city, and is today in first-class condition. Based upon the results obtained in these two cities, this type of construction is to be considered as suitable for paving residence streets, alleys, courts and squares, county roads and highways. It meets the demand for a low-cost, durable pavement, approximating in first cost that of an ordinary macadam road, and in durability that of our better types of street pavements.

THE NEW TIDEWATER PORTLAND CEMENT MILL.

On August 15th the Tidewater Portland Cement Co. formally opened its large Portland cement plant at Union Bridge, Md. Governor John K. Tener of Pennsylvania was present and threw in the switch that put in operation the machinery of the new plant. A special train brought a large number of guests from Baltimore, New York, Pittsburgh and other points to witness the inauguration of the new enterprise, which is one of the largest in Maryland.

The plant of the Tidewater Portland Cement Co. is located at Union Bridge, Md., 45 miles from Baltimore on the line of the Western Maryland Railroad. It is exceptionally well situated, as it commands both the markets of Baltimore and Washington, and is also near enough to tidewater to reach most of the Atlantic seaboard cities at a low freight cost. The plant has a capacity of 1,000,000 barrels of Portland cement and 25,000 tons of hydrated lime, annually. In addition to the above, the Tidewater Portland Cement Co. will manufacture a waterproof cement and also white Portland cement.

The hydrated lime plant has been in operation for about a year and its product is now well known in its territory.

The raw materials at Union Bridge consist of an unusually pure limestone, resembling marble in appearance, and a volcanic shale. These two materials are found side by side within a hundred yards of the mill, and the deposits are practically inexhaustible.

The power plant of the Tidewater Portland Cement Co. is equipped with Rust vertical boilers, which are fed by Roney stokers, and with Wisconsin engines directly connected to large electric generators. All the machinery throughout the mill is electrically driven. Even the elevators and conveyors have their separate motors. All three grinding plants—raw mill, coal mill, and clinker mill—are equipped with Fuller-Lehigh mills. The kilns are 8x125 feet each and were made by the Vulcan Iron Co. The driers and coolers were also made by this firm. The driers are three in number—one for shale and two for limestone—and are arranged so as to take the waste heat from the kilns, making hand-firing unnecessary, and so saving fuel. Each kiln is provided with its own cooler, and these latter are placed below the kilns so that the air for combustion must pass through them, and thus become pre-heated by the hot clinker discharged from the kiln.

The crushers are four in number, one No. 8 and two No. 6's are used for limestone, while the other No. 6 is used for shale. The No. 8 crusher is arranged to discharge directly into the No. 6. The stone is handled by means of pan conveyors. The coal for both burning and power is discharged from a trestle on to a pile, beneath which runs a tunnel, and in this tunnel a belt conveyor. There is also a large clinker storage. The storehouse will hold 80,000 barrels and is equipped with self-emptying bins and Bates valve packers. Avery automatic scales are used throughout the plant, both for mixing and recording.

The officers of the company are: John K. Tener, president; J. T. Fanning, vice-president; B. T. Scott, vice-president; Owen B. Murphy, secretary and treasurer; Richard K. Meade, general manager; R. N. Soper, sales manager; J. Dreisbach, superintendent; Dr. E. A. Slagle, chemist.

GREAT CONCRETE ROOF ARCHES.

The Garnisonskirche, a large church recently dedicated in Ulm, Germany, was constructed without employing obstructing columns. This is somewhat remarkable when the size of the structure is taken into account, the building being 111.5 feet long in the clear and 73.8 feet wide. This was accomplished by using immense reinforced roof arches, the entire structural members being of concrete. The building is carried on concrete piles, about thirty feet long, which are placed in groups under the main foundations at the ends and under the skewback piers.

The roof arches, the most interesting feature of the edifice, may be described as curved beams, quite flat above the apparent springing line. They were designed as arches with a span of 89.5 feet between centers of skewbacks. According to a German authority the arch ribs are 24.6 feet apart on centers. They rise 59 feet from skewbacks to the center point at the crown, and are 1 foot 7.5 inches wide, 6.25 feet deep at the crown and 14.75 feet deep at the skewback. Openings for the side aisles pierce the ribs just above the skewbacks. Concrete beams for carrying the masonry curtain walls are placed between the ribs.

A concrete beam and rib system supported by arches was employed in constructing the ceiling. As both arches and beams are exposed, pleasing effects were produced by building the arches to artistic curves, while the bottoms of the arches and beams were treated with embedded tiles. Ties composed of pairs of steel channels anchored in the skewbacks serve to take up the horizontal thrust. As an investigation showed that steel trusses would be more satisfactory than the designs in reinforced concrete, the former were employed for carrying the roof. To carry these trusses flat beds were molded on the haunches of the arches. This practically reduces the arch loading to the weight of the arches themselves, the beds being nearly over the skewbacks. One end of the steel trusses is carried on rollers, the other being fixed.

NEW SAND-LIME-BRICK CO.

The Range Sand-Lime Brick company, composed of Minneapolis, Duluth and range capitalists, are erecting at Pengilly, three miles east of Calumet, Mich., on the Duluth, Missabe & Northern railway, a sand-lime brick plant which when completed will be one of the largest and best equipped plants of its kind in the United States.

The Architecture and Art Commissions*

To protect the cities from architectural aberrations and from embarrassment of inartistic statuary and commercial monuments and other alleged works of art, it has become necessary to create commissions of experts, whose judgment may be relied upon and accepted as final, in all questions of civic art. This is the primary cause for the establishment of the Municipal Art Commission.

Indeed the purposes for creating Art Commissions in cities and a permanent Commission of Fine Arts in Washington, has rather been a measure of protection than otherwise, protection from inferior architecture and poor art in public work.

For years the cities of America, acting by their duly elected but poorly qualified officials, have in the erection and embellishment of public buildings and the selection of art works, such as pictures, statuary and monuments, heedlessly disregarded the best cannons of taste and the first principles of art. In fact, with very few exceptions, there has been little refinement of taste and almost no display of judgment of art, shown in respect to municipal and state buildings and their decorations and in works of art acquired by purchase or gift.

The result is that there is strewn over the American continent, from ocean to ocean, a class of public buildings, monuments and statuary unfitted for their purposes and environment and of such unpardonable design and workmanship that no self respecting and respected architect or artist would acknowledge them as their own and maintain a high class professional reputation.

The first important city to create an Art Commission was New York. At first as an experiment, it was but an advisory body. Fortunately only the most cultured and accomplished and competent citizens were appointed to this Commission and they acted with such judgment and so thoroughly demonstrated the usefulness and value of such a body to the municipality that by an amendment to the charter of New York the Art Commission was given absolute power over all matters of municipal art, including buildings and structures and their location; and no work of art could be purchased or received as a donation by the city without the approval of this Commission.

To illustrate the power and usefulness of this Commission, when it was proposed to erect another bridge over East River above the Brooklyn bridge, the engineers prepared the plans and let the contracts. The Art Commission, at this point intervened, and in effect said, "You cannot build this bridge because this Commission has not approved the plans; and it will not approve the plans because they provide for a structure without architectural adornment, it is nothing but a bridge, a means to an end. If your engineers will collaborate with an architect or architects, you can make the plans for a bridge just as substantial and without much greater cost and provide an ornate, monumental structure that will combine beauty to its utility." The authorities, who only had in mind a bridge to carry traffic, laughed at the Commission. But the Courts upheld it. The plans had to be changed, and the result is that across East River is another bridge, that is an architectural as well as an engineering accomplishment, admired and pointed to with pride, by all the people of that great city.

The Congress of the United States, after being **particeps criminis** to the perpetration of many crimes against architecture and art at the capitol of the nation, in the buildings erected there and throughout the country as Post Offices and other federal structures and works of art purchased, only as late as 1910, enacted a statute establishing a permanent Commission of Fine Arts and consisting of seven well qualified judges of the fine arts, appointed by the President. This Commission has general authority upon questions of art and the location of statues, fountains and monuments in the public squares, streets and parks, in the District of Columbia and upon models for statues, fountains and monuments erected under the authority of the United States and the selection of the artists for the execution of the same. It is in fact the department of Art for the United States.

It has been suggested, and perhaps many lovers of art will agree, that there ought to be an eighth member of this Commission in connection with many of the works of art that have been perpetrated in the Capitol and which may hereafter be offered for its beautification and that member would be a good, strong, healthy sledge hammer, wielded by the combined strength of the other seven members of the Commission.

The history of the Municipal Art Commission of Los Angeles has been very similar to the history of the Municipal Art Commission of New York. In 1894 it was created by an ordinance of the City Council. This ordinance gave it no authority. It was solely an advisory body, and its advice was rarely asked or desired, though at all times the Commission has been in the main composed of able and competent citizens, well qualified to aid in deciding for the City, matters pertaining to its fine arts.

Upon each occasion since, when the charter of the city has been amended, efforts have been made to make the body a charter body with proper authority, but it was not until the last amendment to the charter that this was accomplished. The Art Commission submitted to the Charter Revision Committee an amendment based upon the provisions of the New York Charter, which proposed amendment I had the honor to prepare. This was not embodied in the charter as submitted, but with some modifications of the authority sought, a Commission was established by amendment to the charter and it is now under this authority that the Commission is endeavoring to discharge its duty.

The charter now provided for a Commission of nine members including the Mayor, the City Engineer and Chief Inspector of the buildings and the head of the department interested in the matter for action, all ex officio members, and five citizens irrespective of sex, having special knowledge or skill in the fine or applied arts.

The Mayor filled this Commission by reappointing the members of the old Commission, who at the time consisted of Mrs. Sumner P. Hunt, Mrs. Hugh L. Macneil, Mr. F. W. Blanchard, Mr. A. F. Rosenheim and Mr. John W. Mitchell.

The first important matter to come before this Commission as a charter body was the submission of the Department of Public Service (which is the new name

*Address by Mr. John W. Mitchell, member of the Municipal Art Commission of Los Angeles, at the meeting of the Southern California Chapter of the American Institute of Architects, held at Los Angeles, Cal., on Tuesday, November 14, 1911.

for the Water Board) of plans for a building for the department to be erected at the S. W. corner of Fifth and Olive Streets. The plans call for an eight-story office building, of an order and style that would be suitable for commercial purposes and not unlike some other office buildings already constructed or in course of construction in the city. The plans were referred to a committee of the Commission and carefully examined and the committee reported against their approval, giving the reasons and this report was unanimously adopted, the vote thereon including that of the President of the Public Service Committee, who was converted to the views and opinions of the members of the Art Commission.

Thereafter the same plans with modifications supposed to meet some of the criticisms of the report, were again submitted, but before they were rejected, as I think they would have been, they were withdrawn and other plans of an entirely different building substituted. A friendly conference between the committee and the architects was held, wherein it was suggested that some important and material changes be made in this design and these being agreed upon and the ideas of the Commission being accepted the plans were approved.

The result of all this is that instead of having a sky-scraping office type building on the S. W. corner of Fifth and Olive Streets, overlooking Central Square, the city will have its first municipal structure embodying a dignified order of architecture and also adapted to its requirements; and while it may be doubted that the Commission can subscribe to the statement in one of the Sunday papers, that this "Will be one of the handsomest municipal buildings ever constructed," still this Commission believes it did its duty thoroughly and that the people of the city will realize, when this structure is completed, that they will have an enduring, monumental, municipal building in keeping with the artistic and progressive spirit of the community and which would not have been the case, if there had been no Municipal Art Commission.

I may add generally in this connection: The design of public buildings, institutional buildings, school buildings and buildings of all description is of grave importance. It is one that the Art Commission believes to be most serious, and its purpose is, hereafter, only to assist in securing the highest architectural achievements. The Commission believes as Emerson has taught. "Our taste in buildings rejects paint and all shifts, and shows the original grain of the wood; refuses pilasters and columns that support nothing and allows the real supporters of the house honestly to show themselves."

Further on this point, I might repeat here that which I have maintained before; that the architecture of public buildings is the most important note in the artistic development of the nation. Great progress is being made in this respect. It is conceded that the Chicago Exposition set an example of architectural purity and consistency that is being imitated throughout the whole country. Unquestionably here in California the classic styles and orders of architecture should be carefully followed, and the language of Thomas Jefferson in a letter to Latrobe, in connection with the upbuilding of the National Capitol at Washington, should be a text. Said he:

"Embellish with Athenian taste the course of a nation looking far beyond the range of Athenian destinies."

And next to the design comes the location of the structure, statue or monument. While viewing many of the architectural masterpieces of Europe, one is struck by the paucity and unfitness of the site and surroundings. How rarely that these great accomplishments have the proper setting. The structure, statue or monument should fit into its site like perfect music unto perfect words.

The awakening of cities to their artistic needs is evidenced by the vesting of artistic authority in Art Commissions and similar bodies. There is a spirit abroad to make the cities beautiful as well as bigger. The quest of municipalities should not be solely for population; nor only the development of the commercial side. Beauty is a city's greatest asset and great cities are realizing this more and more. Paris, which claims to be "The City Beautiful" of Europe, fearing for its prestige, which is threatened by Berlin and other continental cities, is spending millions in making over the city along more aesthetic lines. Berlin, Rome, Vienna and even old London are in a frenzy of rivalry to become more attractive to the visitors entering their gates. And one thing worthy of note, in these European cities, is that its art is not alone for the rich. The state provides works of art in buildings, sculptures and paintings; it is everywhere, on all sides accessible for the rich and the poor alike.

In America much is being done in planning and beautifying in the cities. There is a great civic advancement in this respect. There is hardly a city that is not working out some concrete plan for remodeling and rebuilding upon more artistic lines, including with plans for transportation, sanitation and health, the increase of parks and park areas, their connection by boulevards and the establishment of civic and intellectual centers.

Here in Los Angeles many of our citizens have like ambitions for our beloved city. Commendable aspirations they are, too. But for myself, while I share to the core their hopes, I am growing pessimistic in my expectations. Any suggestion for an appropriation for a Library Building, an Art Gallery, a great Convention Hall or the purchase of works of Art of any character, or even the increase of park areas, is met with the declaration that we must wait. Wait? Which means wait until the city is bounded to its full value and there can be no funds raised by this means—wait until we have the Owens River water, costing millions; Harbors costing more millions; a power plant costing still more millions, a municipal railroad costing still more millions and millions, to accomplish all of which will take years. Thus the commercial side of our life is not only dominating but excluding all else from the consideration of our daily lives.

Of the millions and millions appropriated by the last budget to the different departments and general expenses amounting to over $5,000,000, art for art's sake received the munificent allowance of $300. Instead of the moderate sum of $29,000 asked for by the Commission, for all purposes, this department received 1 per cent of its request. This $300 was for office furniture, but has not been expended because the Commission has not been provided with an office. While as has been indicated the Public Service Commission is to have a half million dollar home, the Art Commission is not provided the quarters called for by the charter, and is housed in the attic of the City Hall, sharing the office of the Housing Commission, where it is an intruder.

Still further along this line, our Library will doubtless remain for years where it is—in a Department Store in keeping with prevailing commercialism. Further, the law authorizes the Art Commission to receive donations of works of Art, but if a gallery of pictures were donated by some opulent and philanthropic citizen, there would be no place to hang them. These recitals but illustrate the attitude of official life

to the art interests and ambitions of Los Angeles, and while it is deplorable to know it is more or less typical of conditions in cities throughout the country.

As to the relation of the Commission to the Departments of the City Government and to the tax payer and citizens of all classes, I believe time will establish a more hospitable and wholesome feeling. Its aims will be better understood and generally respected, for I believe I reflect the sentiments of the present Art Commission, when I say its purpose is not to engage in captious differences with any department of the City Government or any citizen in the discharge of its legal duty. It does not desire to dictate any unmeasurable rule of action, but only to counsel and cooperate with the sole end in view of cultivating the growing sense of beauty and art in all matters pertaining to our common civic life.

And now a word to you gentlemen, personally and as architects: After all, the appreciation of art is a matter of education and understanding and I deem it no small honor to present these views to you, which I desire to emphasize are solely my individual opinions. Upon the members of your profession rests, more than any other, the realization of the artistic ambitions of the nations. To the architects, painters, sculptors, landscape gardeners and engineers, must be left the execution of our artistic hopes and aspirations. By their work, to a great extent, will the public be taught to respect and revere art, which Maurice Denis declares "the sanctification of nature." By your aid can be brought about knowledge of Art's elevating tendencies and refining influences and its help to culture, which is the great need of our social life. Certainly great strides have been made by your profession in the last decade.

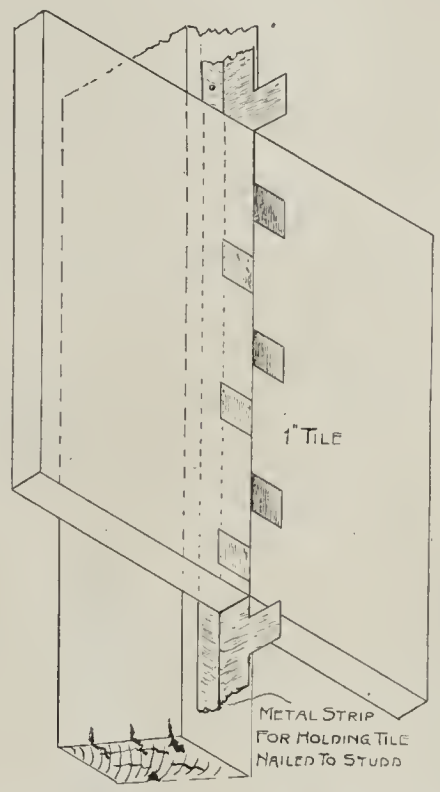
It is for you in planning the buildings of the future to put your artistic beings in your creations. It is claimed that the world is waiting for an "American style of architecture." Some think we have an "American style of architecture." Have we? I hope what we have is not. We have, in many instances, slavish imitations of ancient orders and styles; copies of old masterpieces; enlarged or reduced replicas and temples and palaces, cathedrals and cloisters and utilized for the most utilitarian purposes and without reference to the eternal fitness of things. Only occasionally, through a long vista of failures, is caught a glimpse of the real. Though perhaps after all, the old order will always be the best. It will ever be the task of the architect to put new life into the old architectural themes. That is, perhaps, what is really wanted of you; rather than an American style of architecture. In this connection and in conclusion, I know of no more fitting words than to recall to you a paragraph from the address of a President of the American Institute of Architects, delivered at the forty-fourth annual convention, held in San Francisco, who said:

"Our American ideal need not, must not be expressed monotonously along narrow lines, but must expand broadly under varied skies, under climatic extremes, under varied ethnic and social impulses, unified by our American spirit. This may be if we are to be true to our aesthetic ideal. California is one phase of America, as New England is another and Manhattan is another; these phases are to be nurtured and developed and not swept aside for some manifestation of exotic growth. The American Institute of Architects is deeply concerned in the ethics of business and the profession, in the science of business and the profession, but its passion must be for that beauty which inheres in architecture."

And I add: Inherent beauty is art—and art is of God.

CEMENT LUMBER.

The Cement Lumber System of Cleveland, Ohio, introduces cement lumber, and the means whereby it can be used for exterior and interior walls for residences, hotels, stores, garages, factories, stables, etc., at no greater cost than wooden siding. It can be sawed like ordinary lumber and the same architectural effect accomplished with it, and its superiority in appearance and endurance universally admitted. It is fireproof and practically time-proof—it does not begin to show depreciation from the minute the job is completed, like wooden siding—it does not call for that continual upkeep expense in the way of painting, but it can be painted any desired color. Contemplate a residence with wooden siding located next to the one shown on the accompanying cut—think of the difference in their selling price, of their rental value, of the difference in their upkeep expense for 15 or 20 years, of the difference in their selling and rental values 10 years hence, of the difference in the satisfaction and comfort of living in them, the cement lumber house being much warmer in winter and cooler in summer, more healthy and practically fireproof. Cement lumber is very inexpensive—cement plaster can be had in every town—



View of Tile Attached in Place Before Plastering.

any mortar maker can make cement lumber and any person of ordinary intelligence can learn in five minutes how to make it. Simply mix the mortar and pour it in the moulds and in a few minutes it is hard enough to take out and put in the wall, in sizes of one-half square yard by one inch thick—the labor cost should not exceed two cents per square yard—the moulds are very easily made and inexpensive—$5.00 is sufficient to pay for labor and materials for moulds for any ordinary job and not ten per cent of the lumber is wasted—100 pounds of stucco with two parts sand makes four yards of cement lumber one inch thick—the iron tie stud costs two cents per foot, and it can be nailed on the wood studding and the cement lumber attached, forming the wall as shown in the section for not exceeding four cents per square yard (the tie studding is shipped punched ready to receive nails). These are the elements of cost to the point of plastering and that varies in different localities and is dependent upon whether a smooth or rough finish is desired. For interior walls, stucco and wood fiber (100 pounds of stucco and seven pounds of fiber) is preferable to stucco and sand as the weight is much less, is a better

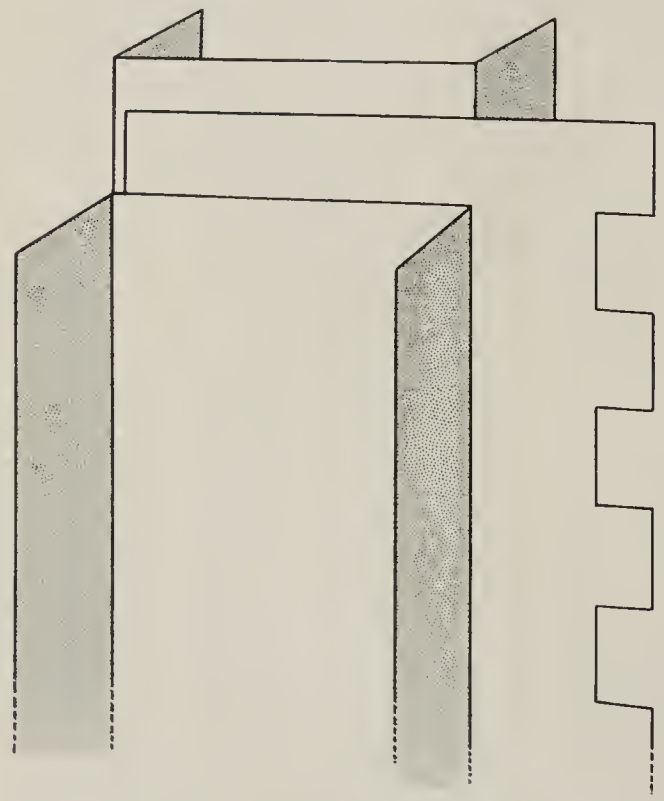
sound register and costs but very little more and works up more easily—this combination makes three square yards. Plaster for cement lumber should not have any retarder in it. Waterproof paper nailed to the wood studding before attaching the tie stud and cement lumber provides against any possible dampness.

For handsome residences any desired finish of plastering can be had, for inexpensive houses only a thin coat is required. This form of construction is especially desirable for stores and other kinds of buildings, in sections of cities and towns where only non-combustible materials can be used and the rental values will not warrant expensive buildings, and in all cases where fire is likely to communicate from point of origin to other buildings.

The tie stud is made of galvanized iron and is punched ready to receive the nails and is shipped in 10-foot lengths, but can be cut to any length with a chisel—this tie stud is nailed directly to the wood studding on 16-inch centers. The tie stud properly attached, ordinary labor can erect the cement lumber by putting it in place and hammering over the bendable prongs of the tie stud—the wall is then ready for plastering.

Moulds.

The moulds are simply long box-like tables, with sides and ends one inch high attached with hinges—the bottom, or table proper, should be of material that will not sag and be straight and level. This long mould is then divided into as many small sections as its length will permit by tacking one-inch strips across it, making these small sections 40½ inches long, so that each unit of the cement lumber is one-half square yard. Moulds should be cleaned after each operation.



Iron Studding for Single and Double Walls.

Making Cement Lumber.

It can be made of any desired size or thickness—the standard spacing of studding is 16 inches and the size of the sections of lumber should conform—the larger the size the greater economy in making and erecting—it handles well in lengths of 40½ inches by one inch thick, each section being one-half square yard. The plaster should not have any retarder for economical manufacture. Mortar should be reasonably thin and worked fast, leveled off with a straight edge and scratched with a wire brush or stubby broom to make a rough surface for plastering, as soon as possible—plaster begins to set in a very few minutes after given water and is killed by being stirred after beginning to set (plaster does not tolerate laziness). Put cheap paper, newspaper quality, in the bottom of moulds to keep plaster from sticking to them—this paper can be had in rolls 16 inches wide and is very cheap. Clean mortar box after each batch and throw away the left over mortar. Stack the tile perpendicularly on edges slightly spaced apart until they dry and never allow them to lean.

Residence of Mark A. Tyndall, Washington, D. C. Exterior and Interior Walls and Porch Columns of Cement Lumber.

SAWDUST CONCRETE.

Sawdust concrete, meaning a concrete in which sawdust is used as part of the aggregate in mixing, is coming into use for certain purposes. Such concrete is of light weight and low tensile strength, but is possessed of some properties that render it quite desirable for indoor uses of some kinds. It is quite elastic, as compared with regular concrete.

Sawdust concrete was put to a novel use in the new Public Library building at Springfield, Mass. It was there used to form a base on which to lay the cork carpet to be employed in covering the floors. The chief object of employing the sawdust concrete was to secure a base into which nails could be driven and which, to a reasonable extent, would hold the nails.

According to a statement made by the company that did the work, it accomplished both purposes in an entirely satisfactory way. After making a number of experiments it was found that the best results were secured by employing a mixture consisting of one part of cement, two of sand and three-fourths of a part of sawdust. The thickness of the layer was one inch. Five thousand square feet of this mixture was laid and after four months of service the indications all are that the material is a complete success.

It is manifest that there is a wide field for the employment of sawdust concrete. Ordinary concrete has been extensively employed for flooring purposes, to which it is well adapted, save that its extreme solidity and lack of elasticity, renders it unpleasant to walk upon. In places where the element of strength need not be considered this form of concrete can doubtless be used to great advantage.

LIMESTONE IS IN DEMAND.

The Carbon Limestone Company of Youngstown, Ohio, reported Friday that never in its history had there been more business done in ground limestone than during the past season. The farmers of Ohio and Pennsylvania are beginning to realize that increased crops have been produced by the product manufactured in Youngstown. About 3,000 tons of the furnace stone have been produced per day, 2,000 tons of railroad ballast and concrete stone of all sizes, and crushed limestone for fertilizing purposes, or approximately 1,500,000 tons this season.

Concrete Pockets Erected by Troy Firm

The new immense reinforced concrete coal pocket erected by the Peterson & Packer Coal Co., of Troy, N. Y., marks a most important advance by that firm and one which has placed it well in the front rank of the big coal concerns of the East. There is no coal pocket like it in this section. Boston has only two and Holyoke has one. These pockets, the latest in architecture, where reinforced concrete is used for business building purposes, are designed by skilled specialists, and, moreover, the work of construction is undertaken practically only by men who have given the work special thought and are able to meet the peculiar problems that arise in putting up a building of this character.

It is a most imposing edifice and practical to the last degree. It is as far ahead of the old coal pocket as the latter was in advance of the coal shed where the coal was practically shovelled off the ground, being protected by sidewalls and a roof. The new affair is built with an idea of greater speed in handling the product and also greater efficiency. It holds 6,000 tons and 80 tons an hour can be loaded into the bins from cars. "That's going some." And with this new system of handling there is a great saving of time. There is no possibility of coal getting into a wagon or a bag unless it has been thoroughly screened by machinery. Not a shovel is touched to it. The wagon is driven under one of the bins marked with the kind of coal wanted. The door or gate of the bin is opened by a lever and the black diamonds pour out freely over a screen and the clean coal, exactly sized, rumbles into the wagon. With the old method it was almost impossible to avoid some slight mixing of tailings and dust with the product that was destined for the consumer's bin; the new pocket with its simple, strong machinery does away with this. It's the latest thing in coal pockets.

Coal Easily Loaded.

With all the handling of this large amount of coal there is no dust about the yard or building; it is all eaten up by the machine. To a great extent a city's coal supply bears about the same relative importance to a community as does the question of water, gas and ice. Coal is absolutely necessary nowadays. The big factories use enormous quantities of it and the many smaller manufactories are not far behind. They make a city, and the question of a handy coal supply is one promptly considered by a new concern. And so it is that such an enterprise as that of the Peterson & Packer Coal Co. is to be warmly welcomed by any community.

The pocket is constructed entirely of reinforced concrete and in its simplest term might be described as a huge box raised on posts of concrete and steel to allow the passage of teams beneath. It looks something like a train shed and a big grain elevator combined, and it has features of both. For instance, cars loaded with coal are taken off the main track where they have been left almost at the door of the place and winched a short distance along a siding until they are inside the structure and directly over a big hopper. There are two of these car sections. The cars have "hoppered" bottoms and when everything is ready the bottom of the car opens downward and the coal pours into a concrete hopper lined with steel sunk below the level of the track. Two endless chains carrying steel buckets between them at intervals of 27 inches pass beneath the opening at the bottom of the big receiving hopper and the coal is carried to the top of the building and dumped into the proper bin. If the coal to be unloaded is chestnut a lever is set that will up-end the buckets on the chain as they strike it, consequently only chestnut coal goes into the chestnut bin and likewise with the other kinds and grades.

Right next door, so to speak, are the wagon runways. There are four of these. While the machinery is at work filling the bins the men may be loading their wagons with no loss of time. A driver places his cart under the gate of the big bin. The gates are of metal plate to which long weighted arms are attached. The gate is opened by pulling a rope attached to the lever arm. This rope passes over a pulley and is within easy reach of the teamster. When the rope is released the weight is heavy enough to return the gate to its original position, which blocks the flow of the coal. As the coal comes through it passes over the screen and from there into the wagon. The screenings are collected in a metal box which is hung from the pocket overhead and is out of the way. The screenings are periodically collected in a hand cart and taken to another part of the grounds to be thoroughly rescreened. Nothing is lost in this process. The coal found takes its place with the sizes, pea and buckwheat, and the dust is sold for a small sum to the owners of brickyards, etc., who can utilize it in their furnaces.

The Facilities a Benefit to the City.

If necessary two cars can be unloaded at the same time and also a stream of wagons could be filled in the open-ended rooms off to one side. There is plenty of space in the structure. Along the front wall a special platform and a special set of dust boxes have been placed for convenience in loading coal into bags. There is an increasing demand that the product be delivered in this way.

Another appointment worthy of note in the matter of time saving is the double set of scales provided for weighing the coal. For ordinary use one scale is used by light and the other by loaded wagons, but in cases of emergency both scales could be utilized, the speed being limited only by the time necessary to throw coal on or off to balance the scales.

The bottoms of the big bins of concrete and steel of course rest on the top of the archways of what might be styled the first floor. This floor of the pocket consists really of a series of segmental arches which serve the double purpose by their high rise of providing additional light for the loading of the wagons and a pitched floor which carries almost the entire volume of coal to the gate openings which are in the valleys between the arches. This means a minimum amount of handling in order to entirely empty the bins.

The outside walls are built entirely of reinforced concrete and those inside are partly of concrete and partly of planking. The planking rests in slots in concrete columns and the bins may thus be increased or decreased in size by changing the planking. If it were desirable the planking could be entirely removed and the vast interior could be made into one huge bin.

The construction is such that all the ties are at the tops of the bins. This feature eliminates the objectionable net work of tie-rods which is necessary in wooden pockets. These tie-rods have been the cause of much difficulty by working out of shape, due to the weight of coal upon them and the consequent throwing out of alignment of the walls.

The pocket is covered by a monitor roof running the entire length of it. The monitor forms the working chamber from which the machine is operated and to this end it is liberally supplied with windows. The motive power is electricity, the switches for which are within easy reach of the operator, and the whole equipment can be set in motion or stopped by the throwing on or off of a switch.

Description of Pocket.

The reinforcement is all in the form of plain round rods, and approximately 200 tons of this material were used. The size of the rods varies from one-fourth to two and one-half inches in diameter. If the rods had all been made of the average size, which would be one inch in diameter, and were placed end to end, they would reach a distance of 143,315 feet, or about 28 miles. This is equal to about one-seventh of the distance from Troy to Boston, or almost the distance from Albany to Hudson, 29 miles. The building, including hopper house, is 110 by 70 feet in plan and 65 feet from ground to the top of the roof. The top of the bin walls varies from 40 to 50 feet above the ground. The pocket is divided into 14 bins of different sizes and holding from 200 to 550 tons apiece. The total capacity is 6,000 tons. While the appearance of a plant of this nature is of secondary importance, even a casual observer will note that this pocket is a long step ahead of the wooden type of construction and its length of life and consequent decrease in maintenance expenses serves to increase its advantages over all other types of construction.

The pocket is trim, neat and businesslike to the last inch and is an imposing addition to the structures which line the water front. The Peterson & Packer Coal Co. is surely to be congratulated on its enterprise and long-sightedness in the completion and successful operation of the new plant.

The plant was designed and detailed and its construction supervised by Adolph Suck, M. E., architect and engineer of Hyde Park, Mass., who is a specialist in reinforced concrete construction and whose work in coal pockets has been extensive.

ECONOMICAL METHOD OF HANDLING STONE AND SAND.

One of the fastest and most economical plants for the handling of stone, sand and gravel, is at the Wilson Avenue yards of the Cleveland Builders' Supply. This plant handles its material from car to bins or wagons, or from bins to wagons with great speed and at very low cost.

The cause of its installation was due to the fact that a great many of the contractors demanded at times immediate delivery, and often this included six to eight wagon loads of stone or sand. This was almost impossible when the loading depended upon hand labor. With the outfit now employed, the delivery can be on its way in less than thirty minutes, and at a cost far less than the old method was capable of doing it. This saving is not only in the handling of large quantities, but also when only in use a short time each day.

This method is not necessarily novel, but is most practicable. There is a large reinforced concrete bin, about 120 feet long, 30 feet wide, and 15 feet high. This bin is divided into four compartments for sorting two grades of crushed rock and two grades of sand.

On top of the wall, running lengthwise of the bin, there is an electric three-ton gantry crane.

The machine is one designed and built by the Cleveland Crane & Engineering Company at Wickliffe, Ohio. It is equipped with a main trolley and a clamshell bucket. Each end of the gantry has a cantilever; one projects out over the cars on one side, while the other projects out over a hopper for loading of wagons.

The crane is able to obtain material from any point of the track adjoining its bins, and deposit it in any one of the bins, or in a wagon, any place along the opposite wall.

Attached to the gantry, and hanging over the wagon drive is a hopper that has three-yards capacity.

This hopper moves with the crane and thus can load a wagon at any point along the side of the bin.

The saving in such an installation is not alone in its ability to handle the stone and sand cheaply, but also to handle it quickly, occupying a very little time to load a large number of wagons, thus releasing the wagons immediately after their arrival, and in this manner they are able to do a much larger amount of work with the same number of wagons, thus of course, cutting down the investment in horses, wagons, as well as drivers.

Formerly it cost on the average of $6.00 per car for unloading the material to storage pile alone, and the service was very poor and irregular. Now with this equipment, the services of one operator and a bucket man to assist only when unloading cars, six to eight carloads can be handled per day easily. This material is handled twice in most cases, as it is first deposited in the bins, and then taken from them and loaded on wagons.

The owners of the plant feel that it has fully paid for itself in economy, and was the very best of an investment as they were better able to give complete satisfaction as to delivery to all their customers.

MINE WATER AND CONCRETE.

The value of concrete for use in mines is coming to be more appreciated than formerly. One thing that has tended to limit its use in mines has been the unsettled question as to the action of mine water, usually more or less impregnated with acids, upon the concrete. Considerable valuable information has been secured on this point from observations and tests made by R. D. Richardson, concrete engineer for the coal mining department of the Delaware, Lackawanna and Western Railroad. The observations and tests were made in the Scranton, Pa., district, and the conclusion reached by Engineer Richardson is that the mine water there produces no deleterious effect upon dense concrete, in the making of which proper materials have been rightly employed. An analysis showed that the water contained one-fourth per cent of sulphuric acid.

A reinforced concrete dam has been subjected to the action of the water analyzed for three years without producing any deteriorating effects. Pieces of steel imbedded in small blocks of concrete were found to be entirely bright after they had been immersed in this mine water for fifteen months. The result of Mr. Richardson's tests and observations are the more gratifying because there have been numerous instances reported of the utter destruction of concrete subjected to the action of mine water. In the opinion of the engineer such failures were due to the porosity of the concrete and the poor materials employed in making it.

ROTARY KILN.

Allis-Chalmers Co., Milwaukee, Wis., write us that they have in stock for immediate shipment an 8 ft. by 135 ft. rotary kiln, which they offer at a very attractive figure.

Power Developments in Minnesota

The Consumers Power Co., of Cannon Falls, Minn., have completed this summer two hydro-electric generating plants, involving the use of 36,000 cubic yards of reinforced concrete. A comparatively new type of dam was adopted, which is hollow and depends for its stability, not upon its weight alone, but makes use of the water pressure on its inclined upstream face to force the structure more firmly against its foundation. The older gravity dam with vertical upstream face, could not be designed so as to stress the concrete nearly up to its safe limit, and concrete is an expensive material to use only for its weight. One solution which has been tried out extensively in New Zealand and elsewhere for short dams in gorges, makes use of the arch design with a thin shell, but engineers in this country have found few opportunities for its use. For American conditions, another design is needed. What promises to be a solution, reducing the materials required and stressing all the members up to nearly their allowable values, is the hollow buttressed type mentioned above. At Rapidan and Cannon Falls, Minn., hollow dams of the latter type were constructed and offer many features of interest. The H. M. Byllesby Co., of Chicago, were the engineers and constructors of all except the dam, which was designed and built by the Ambursen Hydraulic Construction Co., of Boston, Mass.

Tainter Gate Section of Concrete Dam, Showing Roadway, Rapidan, Minn.

The several accompanying pictures show the magnitude of these two developments. The first, that near Rapidan, is a plant developing 2,300 horse power with an ultimate capacity of 3,500, the water wheels operating under a head of 62½ feet. The power is transmitted to Mankato, nine miles distant, where it is transformed down for supplying city lighting and power service and for operating street railways. This plant will be connected by a transmission line with the plant at Cannon Falls, the two furnishing power for several nearby cities and towns. The dam is on the Blue Earth River and develops a rapids and falls into a head of 53½ feet at its crest, but being equipped with 8-foot tainter gates, develops a working head of 62½ feet. It impounds a lake six miles long, having an area of about 550 acres. The dam itself is hollow and of reinforced concrete. It is 500 feet long, of which about one-half is spillway. It consists of fifteen bays or cells, separated by concrete buttresses 2 feet thick, and 159 feet wide from the upstream to the downstream toe. Spanning these buttresses upstream is a concrete deck sloped at 45 degrees, against which the water presses at such an angle that the structure becomes more stable as the head increases. On the downstream side, an apron is carried downward with a reverse curve so as to discharge the water without impact into the pool below. The buttresses are carried down to bedrock as are also the decks, making a dry interior. The buttresses are carried up high enough to accommodate not only the tainter gates by which the height of the pool is regulated and which allow the passing of flood waters without damage, but also carry a reinforced concrete road structure of 39-foot spans resting on 18x24 inch beams. This was made necessary by the flooding of the old road upstream from the site of the dam.

It will be noticed that the power house is an integral part of the dam, replacing the apron on the lower side, but being identical in structure on the upstream face. This is made possible by the hollow construction, the entire water pressure being carried by the buttresses, and the apron on the lower side being added merely to make possible a smooth descent for the water. In this construction 20,000 cubic yards of reinforced concrete were used.

The spillway capacity is designated for the safe discharge of 30,000 cubic feet of water per second in case of flood, which is about one-seventh of the Niagara Falls flow. An interesting feature of this design is the use of four 5x7-foot sluice gates, whose openings may be seen at the left at the pool level. They are operated from platforms within the hollow cells of the dam. Thus the interior of the dam is partly used as a working chamber at the spillway section and for the housing of turbines and equipment at the power house end. The power house is of poured concrete 73x38 feet, cast integral with the buttresses.

The plant at Cannon Falls is much similar except that a longer spillway section was used. The total length of the concrete section is a little over 1,000 feet and the spillway length is 414 feet. It develops

approximately the same head and will ultimately have the same power capacity. Work on this dam was begun early in March of 1910 and was completed in nine months, remarkably good time for heavy construction of this nature. The power house in this case is also an integral part of the dam and is 54x92 feet in plan, extending 85 feet above the foundations. Sixteen thousand five hundred yards of reinforced concrete were used in the dam, requiring 23,500 barrels of Universal Portland cement. Seven hundred and fifty thousand pounds of reinforcing steel were required.

The advantages of concrete for construction such as this are self-evident. There is no part of this structure which is subject to deterioration except the steel gates, which may be kept painted and which may be readily renewed. It is an economical use of concrete, in that the structural members are designed to take their full allowable load under flood conditions, no material being wasted in massive construction, whose only value lies in its furnishing weight to prevent the overturning of the dam. This is a type impossible to construct in masonry, but well adapted to reinforced concrete and promises to largely replace the gravity type in future construction.

THE TRANSPLANTING OF A FOREIGN BELT.

For many years Victor-Balata belting has been manufactured in Germany and imported into America by the New York Leather Belting Company. While this was satisfactory as far as obtaining the quality feature of the belt was concerned, there were always delays due to importation and attendant duty costs, so that it was finally decided to erect a plant in America. On May 1 the Victor-Balata Textile Belting Company opened its new plant in Easton, Pa., for the manufacture of this belting in America. This move simply means the transference from Germany to this country of many of the men and most of the unusual facilities used in making belting there, and is not at all like starting to manufacture the belting over here with green and inexperienced help and untried machinery.

The new company is composed of German and American interests which have been connected in a business way in the Balata belting line for many years. German members of the company are connected with the well-known German belting manufacturers, C. Vollrath & Sohn, Blankenburgh, Germany. The American members are Messrs. C. E. Aaron and J. R. Stine, of New York, the former being president and

Front View of Main Building.
New Factory at Easton, Pa., of Concrete Construction.

the latter secretary and treasurer of the New York Leather Belting Company. Mr. Aaron is president of the new company, Mr. Stine vice-president and treasurer, and Mr. Edwin Vollrath secretary of the company and manager of the Easton plant. Mr. Vollrath is a grandson of Mr. C. Vollrath, senior member and founder of the German company, who has for many years made Balata belting in Germany. He was brought up in the textile belting business and is familiar with the making of Victor-Balata belting from beginning to end. The superintendent of the foreign plant spent several months in America teaching the workmen at Easton all the details of the many processes entering into the making of Victor-Balata.

The new factory buildings are of steel and concrete construction, most substantially built throughout. The total amount of manufacturing floor space is approximately 30,000 square feet. The special siding from the

Rear View of Main Building Showing Power Extension.

Lehigh Valley railroad assures ample shipping facilities. A power plant of the most modern description is in a special building of its own. It is in the form of an "L" running out from the main building. Two hundred horsepower, high pressure water tube boilers of the E. Keller Company make have been installed, as well as a Corliss engine made by Hughes & Phillips Company.

Special machinery involved in the many processes of belting manufacture was imported from Germany. The entire plant has been laid out with a view of the most economical manufacture of textile belting in all its detail. The New York Leather Belting Company has decided to entirely separate the textile from the leather belting business. While the new textile factory is at Easton, the sales end of the business will be handled from 51 Beekman Street, New York, and 172 North Franklin Street, Chicago, the sales office of the new company.

CONCRETE BATH TUBS.

"Unless you have been in the tropics," remarked the man who had just returned from a trip south, "you can't possibly realize how great a luxury a cold bath can be. It's not that the climate is necessarily warmer than a New York summer, but the natives have worked out the problem of bathing to its ultimate conclusion. They have invented the ideal tub.

"On the great private estates in Mexico baths are in use today which were hewn out of the solid rock centuries ago by slave labor. They are located, for the most part, in the vicinity of running water, and are fed by bamboo pipes; but in many cases they have to be filled by the old fashioned method of carrying a bucket to and from the spring.

"In the cities the so-called stone baths are made of cement concrete. The residences of all well to do people are provided with them, and they are a feature of the native hotels. They are usually about ten feet long by four deep, baby swimming tanks in fact.

"The tropical custom is to fill the baths late at night. By the following morning the water will have acquired a limpid coolness that acts like a tonic upon the body. When one remembers that near the equator it is almost as warm in the morning as it is at noon, and that water taken direct from the city mains is always tepid, the advantage of the stone or concrete bath is evident."

Prevention of Corrosion in Metal Lath

By Clarence W. Noble

For the past year the writer has been investigating corrosion in steel and the methods of preventing it. The object of the investigation was to determine what improvement, if any, could be made in the protective coating used on Herringbone metal lath. The investigation brought to light much interesting technical information.

The nature and cause of corrosion was first studied. A very exhaustive investigation of the corrosion of iron and steel exposed to the atmosphere has been recently made by Dr. A. S. Cushman, of the U. S. Department of Agriculture. While his studies were confined primarily to the corrosion of fence wire, the results are of general value. He states that corrosion is primarily due to the presence in the air of minute quantities of carbonic acid and sulphurous gases. These acid gases are dissolved in falling rain and thus brought into contact with the iron. Their action then depends on the condition of the metal. If it is absolutely uniform in quality the attack is exceedingly slow and impotent. If, owing to the localized presence of impurities, different portions of the metal vary in electrical conductivity, then the acids and the varying portions of the metal form a miniature electric battery. A current is set up and that portion of the steel which is electro-positive as compared with the surrounding metal will be corroded. This explains why certain fence wires will corrode while others with the same exposure will last for many years. The local presence of impurities also explains why steam boilers will pit instead of corroding uniformly.

The action of wet plaster on metal lath depends on the nature of the plaster. Portland cement and lime plasters are strongly alkaline and will not allow the formation of acids in their presence. They therefore prevent the rusting of metal lath. The protection given by Portland cement is a permanent one. Lime plaster, however, has a greater attraction for moisture than Portland cement, and while lime protection may be permanent, still need is felt for further investigation before making a definite statement. Such investigation was not made, as the matter is a diversion from the subject in hand.

Plaster of Paris, which is the base of the many brands of patent and hard wall plasters, is actively corrosive. During the setting up process it has in a marked degree the tendency to start electric currents, and these currents cause the oxygen molecules which are momentarily freed by the chemical changes, to attack the steel. The corrosion is much more rapid than that due to atmospheric exposure. Iron rust, once started, works progressively, and the rusting in this case continues long after the chemical changes in the plaster, with their resulting electric currents, have ceased. It only requires the presence of a normal amount of atmospheric moisture to keep the action going.

The different types of protective coatings which were studied fall naturally into three separate classifications—paints, electrical insulators, and galvanizing coatings. Each of these works on a different theory. 1. The painted coating is merely an attempt to shield the steel from the plaster. If well done with an undiluted oil paint, it has some value. Linseed oil is subject to attack by lime and plaster of Paris, becoming what is known among painters as "dead." It is then porous and will not prevent corrosion. The first attack of the plaster is, however, expended on the paint instead of the steel, and for this reason the paint coating is of assistance. If the paint holds until the electric currents cease it has served a useful purpose; if not, it has at least delayed matters.

Metal lath should be coated with an exceptionally tenacious material. It is shipped in bundles and roughly handled during erection, and the coating is severely tested by scratches. In this respect even the best paint leaves much to be desired. Of course rust will immediately start at each scratch. If in the effort to reduce cost the manufacturer dilutes his paint with gasoline, the resulting coating is valueless, although it can be made cheap. Unfortunately most paint used for lath protection is thus diluted. Everything considered, the paint coating has the least to recommend it of any of the three types of protection considered.

The coating with electrical insulators proceeds on an entirely different theory. The attempt is here made to prevent the electric currents from reaching the lath. The cold japan coating used on Herringbone lath is of this class. It consists of an asphaltum varnish which is oxydized by the addition of a chemical dryer instead of by baking. It is proof against the action of all types of plaster and is a perfect insulator as long as the coating itself is perfect. The objection to it is that it is impossible to make it proof against the wear and tear of handling. If it is sufficiently elastic to prevent chipping, then it will scratch. There seems to be no neutral territory between these two difficulties. Its cost, five-eighths of a cent per square, is in its favor. While rust will start at the open scratches, the attack can never, as in the case with paint, be made through a "dead" coating. It will probably be long before it will be replaced for medium-priced work.

Galvanizing coatings work on still a different theory. The electric currents are here allowed to circulate at will, while their mischief is prevented. It has been previously stated that the currents flow only between metals which differ in electrical potential and that the attack is on that metal which is most strongly electro-positive. Now all zinc is more electro-positive than any commercial steel, regardless of its impurities. A coating of zinc, therefore, will cause the currents to run between the steel and the zinc instead of between the different portions of the steel, and the attack will be invariably taken by the zinc. Freedom from scratches in this method of protection is unessential. It is only detrimental when the steel is so far exposed as to disclose a localized impurity (a potential rust spot) entirely surrounded by exposed steel. In this case the rust spot would develop. So true is this that metal lath cut from galvanized sheets with all the raw edges exposed will show most excellent results.

In the search for a perfect protective coating only one type of paint, Marine Tocholith, was tried. This is not a mixture of oil and pigment, and is therefore, strictly speaking, not a paint at all, but as its action is similar to paint, it will be discussed here. It is a modified Portland cement. Its advantage is due to the fact that it has the property common to all types of Portland cement, of preventing rust and absorbing a small amount of rust already started. It grows harder with age and in time adheres very tenaciously to the steel. It was found that it would not attain

sufficient hardness to stand bundling and shipping for several weeks. The manufacturers submitted a special sample designed to harden with unusual speed, but even this was not commercially feasible. It was rejected on account of its liability to scratching.

Two insulating coatings were considered, a baked and a cold japan coating. The cold japan is merely an improvement in the coating which has been used on Herringbone lath for several years. It was adopted to replace the old cold japan coating, but on account of the liability to scratching is not considered absolutely perfect coating. The baked enamel coating is used to a certain extent in the United States. It requires considerable expenditure for plant and only partially overcomes the scratching difficulty. When the lath is bent in forming cornice work the enamel is very apt to break. It is very expensive and is not regarded as sufficiently satisfactory to justify the cost.

A new metal called ingot iron was also considered. This is being used for the manufacture of Herringbone lath in the United States. The impurity which causes variation in electric potential in steel is manganese. A very slight variation in the percentage of manganese makes a wide variation in electric potential. As it seems to be impossible to secure an absolutely uniform distribution of manganese, the manufacturers of ingot iron have made a product in which this and practically all other impurities are omitted altogether. Electric currents are therefore not set up in ingot iron as the result of an acid bath, and corrosion is much slower. Acid tests with ingot iron show remarkable results. Tests with plaster were not sufficient to give a satisfactory verdict.

The metal was rejected for an entirely different reason. Lath cut from ingot iron looks exactly like lath cut from ordinary steel sheets. An architect or contractor purchasing lath for an important contract and paying an additional price for the best material, wants something more than the assurance of the manufacturer that he is getting the quality he is paying for. He wants the assurance of his own sense. The lack of this cannot be overcome with ingot iron.

Four types of galvanized lath were considered—hot galvanized, electro galvanized, Sherardized, and lath cut from a galvanized sheet. None of these require description except the Sherardized coating.

This process was invented in England by Mr. Sherard Cooper-Cole, a noted metallurgist, some seven years ago. The metal to be treated is packed in zinc dust and baked for several hours at a temperature just below the melting point of zinc. The process and the result is very similar to case hardening. Just as the casting while being case hardened absorbs part of the carbon in which it is packed, so the metal lath while being Sherardized absorbs zinc. The process differs from case hardening in the formation also of a pure zinc coating on the outside of the steel, while no corresponding coating of carbon is formed on a casting.

As galvanizing offers a perfect solution to the difficulty regarding scratches, the investigation now began to narrow down to a choice between these four types. Tests, however, which will be described later, were being made at this time which showed the probability of considerable damage to the zinc by plaster. It was therefore suggested that the coating should be lead instead of zinc, as the formation of lead oxide would protect the lead coating from further destruction. Mr. G. Frank Allen, a noted metallurgist, was consulted. He reported that the suggestion was of no value because lead is electro-negative as compared with iron, and the iron would therefore be rusted at the expense of the lead. He proposed an alloy of lead and zinc mixed in such proportion as to be neutral toward iron. This was rejected as again opening up the difficulty regarding scratches.

The simplest manner of making galvanized lath is to cut it from a galvanized sheet. With Herringbone lath the results are very satisfactory, although the coating is frequently cracked at the bends. Whether it would prove so in the diamond mesh type, where the bends in the metal are much more frequent remains a question. The process was rejected on account of its commercial impracticability. To a technical man who understands how galvanizing protects, there is no difficulty apparent from the raw edges of the strands. It would, however, require considerable explanation to sell such lath to the average layman. Plato once said that a man's reputation is more injured by telling an improbable truth than a plausible lie, and the statement is as true today as in Plato's time. If nothing better had been found the process would have been adopted, but was finally rejected.

Hot galvanizing was rejected on account of the cost. The result is not better than that obtained by Sherardizing, while the cost is about eight times as great.

Electro-galvanizing was rejected on similar grounds. This process is really zinc electro-plating. In order to be efficient there must be sufficient zinc deposited to supply the wasting while the electric currents due to hardening of the plaster are in progress, and still leave an ample residue for further protection. Perfect color is obtained with a quantity of zinc entirely insufficient to provide perfect protection. It is also much cheaper to provide color than protection, and unfortunately mere color satisfies the manufacturer. For this reason many American architects in specifying galvanized lath are now stating that it must not be electro-galvanized. By continuing the process any desired quantity of zinc can be deposited, but if sufficient zinc is provided to give a coating equal to the Sherardized coating, the cost would be many times as great.

The Sherardized coating which was finally adopted differs from other types of galvanizing by reason of the zinc iron alloy coming between the pure zinc and the steel. Immediately beneath the surface will be found a thin coating of alloy which is almost entirely of zinc. Going further, the percentage of zinc decreases, while the iron increases until pure iron is reached. There is therefore no contact between two metals of appreciable variation in electric potential. The coating can be considered as made up of a large number of layers, each varying slightly in electric potential from those immediately above and below it. While electric currents doubtless exist in these layers, they seem to be very weak and very minute and their effect is quite insignificant. A given quantity of zinc is far more efficient in the Sherardized coating than when applied in any other manner. Prof. Burgess of the chair of metallurgy of the University of Wisconsin, reports that a given quantity of filings from the Sherardizing alloy takes fifteen times as long to dissolve in acid as a like quantity of zinc filings from a hot galvanizing bath.

Another reason for choosing Sherardizing is that the process cannot be scamped and is practically proof against mistakes in the shop. The zinc dust in which the lath is baked is a very poor conductor of heat. The process starts at the outside of the drums long before it starts at the centre, yet heat must be kept up until the centre is being Sherardized. Conversely the process is still going on at the centre for some time after the drums are removed from the oven. The real protective is the alloy which is deposited before the pure

zinc. If, therefore, pure zinc appears at the centre of the sheet, one can be sure that the process is perfect.

In order to assist in the selection of a proper coating an attempt was made to devise an accelerated test applicable to the case in hand. The commonly used acid tests do not represent anything like working conditions. Patent plasters are not acids.

A number of specimens were coated with pure plaster of Paris and kept for two weeks in a bath of exhaust steam. It was supposed that they would thus receive in a short time the effect of as much moisture and warmth as would ordinarily act on them in a long period of years.

The result was a disappointment. The temperature was above the melting point of asphaltum, and the cold japan coating had consequently been absorbed into the plaster. Plain uncoated lath ingot iron and cold japanned lath all looked equally rusted. All types of galvanized lath showed rust spots, although the electro-galvanized was much the worst of the lot. The samples were submitted to Thomas Heyes & Son, consulting chemists, for further examination. They reported that the only reason the galvanized coatings looked better than the bare lath is that iron oxide is red, while zinc oxide is white. Actually there was more loss through oxidization of the zinc than of the iron.

By this time evidence obtained from other sources had shown the superiority of the Sherardized process. It remained, however, to see whether the plaster test would develop any unknown weakness. The chemists were instructed to conduct a series of tests on cold japanned and Sherardized samples. These were coated with pure plaster of Paris and carefully watched for five months. From time to time bits of the plaster were chipped off. The plaster film remaining in contact with the lath would then be scraped off and carefully analyzed. From the first these samples showed minute quantities of zinc oxide and metallic zinc dust. This is doubtless loose dust left on the coating from the manufacturing process. The first test showed 0.18 per cent of such dust, but no later tests showed as much as this. No trace of zinc sulphate or iron oxide was formed in any sample, although they were watched for carefully.

The cold japanned sample showed iron oxide at the exposed ends, while the edges of the Sherardized sample were clear. Otherwise the results from the cold japanned sample were as good as the other.

The chemist stated that "forever" is too long a time to be considered in a careful scientific statement. His tests showed, however, no reason to suppose that Sherardized metal lath in a gypsum plaster would not last for a number of generations.

In comparing galvanizing, the quantity of protecting zinc must always be considered. Prof. Burgess found that chemically pure zinc from an electro-galvanized coating from a hot process bath, and that the Sherardized alloy was fifteen times as efficient as the hot galvanizing zinc. This was for equal quantities of metal. The excess zinc or hot galvanized material is wiped off wherever this is possible. Average tests show the commercial Sherardized coating to be two to three times as efficient as a wiped hot galvanized coating, but the latter requires much more zinc. Such a hot galvanized coating is also superior to the electro-galvanized coating as commercially applied, yet if the same amount of zinc were used in both processes the electro-galvanized coating would be much the superior.

Metal lath when hot galvanized cannot be wiped off, and a very heavy coating of zinc is the consequence. Our tests would indicate the probable superiority of Sherardizing over even this very heavy coat, although the cost is only about one-eighth as great. A conclusive test of this point was made by Mr. J. H. Burn-Murdock in England. He had one-half a chain hot galvanized without wiping and the other half Sherardized. Both chains were hung in sea water. When they were finally removed the hot galvanized chain had lost all of its coating and was so badly rusted that some of the links could be broken in the fingers. The Sherardized chains had turned blue. There were occasional yellow patches which were rubbed off without showing pits or roughness below, and all the links were evidently as strong as when originally immersed.

CONCRETE BLOCKS IN NEW YORK.

At a conference of the superintendents of buildings of the five city boroughs of Greater New York, the following regulations were adopted governing the use of hollow concrete blocks in building construction in that city:

Hollow concrete building blocks may be used for buildings not more than three stories nor more than 36 feet in height, under the following conditions:

No hollow concrete blocks shall be used unless made of the following composition: One part Portland cement, and not more than five parts of clean, coarse, sharp sand and gravel, or a mixture of at least one part of Portland cement and not more than five parts of crushed trap rock or other suitable aggregate approved by the superintendent of buildings. The aggregate shall be of such fineness as to pass through a one-half inch ring and be free from dirt or other injurious matter, and Portland cement shall be a true Portland and be up to the standard requirements set by this bureau.

All concrete blocks shall be cast true and square, and be of uniform shape and thickness when laid in courses. No such blocks shall be used until complete and satisfactory tests have been made by the manufacturer under the direction of the superintendent of buildings, and until an approval for the use of such blocks has been obtained.

No blocks shall be approved that do not at the age of 28 days develop a compressive strength of at least 1,500 pounds per square inch of net section.

In no cases shall the hollow spaces of the concrete block exceed 33 1/3 per cent of the cross-section of the block. The thickness of walls or webs of such blocks shall not be less than one-fourth of the height of the blocks, but in no cases less than 1½ inches.

The thickness of walls for any buildings where hollow concrete blocks are used shall not be less than is required by the building code for brick walls. All such walls shall be laid in Portland cement mortar. All outside walls below grade must be filled in solid. No walls composed of hollow concrete blocks shall be loaded in excess of 100 pounds per square inch of the gross section of the wall—that is, no deduction being made for hollow spaces in figuring the area.

Where beams or girders rest on such walls, suitable templates of iron, steel, or stone shall be provided under their ends, or the blocks under them shall be solid. Concrete lintels spanning an opening over 3 feet 6 inches wide shall be reinforced by steel bars.

Every block must have stamped thereon the name of the manufacturer or the manufacturer's mark.

All walls of hollow concrete blocks, and beams used in same, must be anchored in accordance with Sections 41 and 60 of the building code.

The Purchase of Fuel Upon a Heat Unit Basis, in Germany and Switzerland

By John B. C. Kershaw

Considerable attention has been given in the United States to the methods of purchasing fuel upon a heat-unit basis, and the action of the government in arranging for the application of this system of purchase to all government contracts has given a great impetus to the movement for the use of scientific methods in the purchase and control of fuel supplies.

In view of the widespread and general interest in the subject in the United States the writer has thought that the following details of the progress of a similar movement, in Germany and Switzerland, would be found interesting.

In Germany considerable progress has been made during the last two years. In their report for the year 1909 the committee of the Hamburg Smoke Abatement Society states that an increasing proportion of the members of the society are taking samples and having tests made of their fuel deliveries. Over 1,000 fuel tests were made at the official testing laboratories of the society in Hamburg in 1909, and it is expected this total will be largely exceeded by the figures for 1910 and 1911. The chief engineer of the Hamburg Smoke Abatement Society (Herr Nies) is firmly convinced of the value of chemical and calorific tests for checking the quality of the deliveries of fuel. This society, which had at the end of 1909 305 members and over 1,300 boiler and other furnaces under its control, has arranged to undertake the regular sampling of their fuel supplies for those members who desire to be relieved of this work. This is a great step in advance, for to obtain a really fair average sample of coal or slack demands more skill and knowledge of sampling than is generally found in those who are trusted with this work, and the slow progress of the movement for more scientific control is partly due to this difficulty.

The actual testing of the fuel sample in Hamburg is undertaken by an independent fuel expert, Dr. Aufhauser, who is head of the Thermochemische Prufungs and Versuchs Austalt, or in plain English, of the Thermochemical Testing and Research Laboratory in Hamburg. The following are the details of the basis upon which the fuel is valued:

An average sample of the fuel is taken from the first or trial delivery after discharge at the consumer's works, and this is carefully tested at the official testing laboratory for moisture, ash and calorific value. The latter value is calculated on the assumption that the products of combustion of the fuel pass away in the state of vapor at 212° Fahr.—and with the aid of this result the calorific value of the combustible portion of the fuel is also calculated.

The regular samples of fuel taken to check the quality of the further deliveries are only tested for the percentage of water and ash; and from the results of these tests the calorific value is calculated by the aid of the figures obtained from the first or guaranteed test. Should this calculated value deviate in either direction from the guaranteed value by more than the difference allowed by the term of the contract, an addition to, or deduction from, the price follows.

In those cases where doubt exists as to the correctness of the results, which in some cases may vary on account of a change in the calorific value of the combustible matter of the coal, the sample is submitted to all three tests, and if a different calorific value is found by the direct test, a correction is made accordingly.

It will be seen that this method of checking the fuel deliveries differs in two respects from that practiced in this country. In the first place the guaranteed calorific value of the fuel is based upon the "combustible" matter in the same, and is calculated for gases escaping at 212° Fahr.; and in the second place, the regular samples of the fuel are only tested for moisture and ash, and the calorimeter tests are only repeated in cases of dispute.

As regards these modifications there is no doubt much to be said for the change. A fuel consists, from the practical man's point of view, of combustible and incombustible matter, the latter being made up of water and ash. If the fuel comes always from the same seam in the same pit the calorific value of the combustible portion of the coal ought to be a constant

Medusa White Portland Cement Used for Exterior Finish. H. H. Hart Residence, Claremont, Cal.

and not a variable value. The variables are the moisture and ash, and by estimating the percentage of these in each sample, and then calculating the value of the remaining combustible by aid of the value obtained in the first test, one can obtain the calorific value of the fuel actually delivered, with a minimum of time and expense.

But, this system of valuation ought to be checked, say, monthly or quarterly, by repeated tests with the calorimeter of the actual calorific value of the fuel, and the latter figure should be used until another determination is made. This will guard against errors due to the slow changes in character and quality, which undoubtedly occur in the working of some seams of coal, especially when the thickness is diminishing. It is also advisable to have some guarantee that the deliveries of fuel are from the mine and seam of coal stipulated in the contract. Mine managers often ship other coal than that bought, unless a penalty is arranged for such conduct.

As regards the assumption that the exit gases from the combustion of the fuel are always cooled to 212° Fahr., and the correction of the calorific value accordingly, this method of expressing the value is supposed to have the advantage that it renders the calculations of the boiler efficiencies more simple, and

that one can more easily judge from the calorimeter test results the actual steam-raising capacity of the fuel. As a rule, English and American calorific test results are based upon the escape of the gases at 15° C. and the value obtained in English, American and German calorific tests of fuel are, therefore, not comparable, until allowance has been made for this difference in the method of calculation. But no boiler is so efficient as a heat abstractor that the exit gases escape at the temperature of 212° Fahr. The German test results therefore, still require correcting for the difference between 212° Fahr. and 560° Fahr., or 600° Fahr., which is generally the temperature of the escaping gases, and the simplifying of the calculations required when estimating boiler efficiencies is thus more apparent than real.

Below are a group of test results calculated on this basis obtained at the official fuel testing laboratory of the Hamburg Smoke Abatement Society and taken from the last annual report of the society:

	Moisture.	Percentage of Ash.	Combustible.	Calorific values in centigrade units. Raw coal.	Combustible.
Durham coal.....	1.6	2.2	96.2	7951	8273
	4.6	15.8	79.6	6339	7999
	2.6	6.9	90.5	7350	8139
Northumberland coal.	1.4	13.4	85.2	6907	8115
	5.4	8.7	85.9	6840	8001
	12.1	5.5	82.4	6413	7871
Yorkshire coal.....	3.5	7.3	89.2	7145	8034
	6.4	4.8	88.8	6987	7912
	3.7	3.3	93.0	7526	8116

The above caloric tests require multiplying by the factor 1.8 to obtain the corresponding values in British thermal units, and it will be seen that there is a margin of 402 Centigrade units (723 British thermal units) between the highest and lowest results when based on pure coal or combustible. This difference proves that even after the two variables, moisture and ash have been eliminated from the coal considerable variation exists in the calorific value of the coal mined in different collieries and seams in the North of England and that the Hamburg system of valuation, if adopted, must be used with discretion and common sense.

As regards the progress of scientific methods of controlling fuel supplies in Switzerland the state authorities of that country established in 1907 at a cost of $10,000 a well-equipped fuel testing laboratory at Zurich, and have since 1908 based all contracts for the supply of fuel to the State railways upon calorific tests.

The principle employed here is to fix an average heat value for the fuel being delivered (in this case German and French briquetted fuel) and to deduct from or add to the price a proportionate sum for every 50 heat units (90 British thermal units) by which the calorific value as delivered differs from this standard. An illustrated description of the State fuel testing laboratory at Zurich appeared in the issue of the Engineer for June 12, 1908, and it was there stated that over 3,000 samples of fuel had been tested in the first year of its existence.

Most of these represented German fuels, for Switzerland has to import all her coal, at an annual cost of $15,000,000. The remaining samples were of Belgian, French and English fuels.

The director of the laboratory at Zurich, Professor Coustam, has stated that this extensive examination of imported fuels in Switzerland, both for the State and private consumers, has tended to enlighten the buyers as to the qualities and economic value of the fuels from the various countries and collieries and has also contributed toward the classification of fuels according to their heating power or value.

In a recent letter to the author of the present article Professor Coustam confirms this view, and asserts that fuel testing in Switzerland is centralized at the State Fuel Testing Laboratory where practically all fuel for railway and gas-making purposes is tested regularly—i. e., a sample being taken from every twentieth carload of coal as it arrives. In 1909 4,000 samples, and in 1910 4,400 samples were tested calorimetrically, besides about 1,000 samples of gas-coal tested for moisture, ash, volatile matter and sulphur.

All parties concerned (producers and consumers) appear to be satisfied with the methods of fuel testing, the former agreeing that they are thereby protected from unjustified complaints. The results of the tests are compiled monthly, and are communicated to the sellers and buyers, the monthly mean serving as a basis for payment.—Metallurgical and Chemical Engineer, Liverpool, England.

NEW INDUSTRY FOR CEMENT MEN.

Concrete manufacturers in every town are now offered a new industry in connection with their regular work—namely manufacturing the Automatic Sealing Burial Vault, which is made with steel forms manufactured by the Automatic Sealing Vault Co., of Peru, Indiana.

The strong features about this vault are its neatness and beauty of design, its simplicity of construction, and the absolute certainty of the perfect seal. It is moulded from concrete in adjustable steel forms, and the patented cover and body meet in such a way that water can never enter, even though no cement seal be used.

There has long been a need for such a vault as this. Wooden boxes soon decay or crush under the weight of earth above; stone, brick and metal vaults become mere cisterns to hold the water of the earth; and the thought of using them is repulsive to sensitive minds. The only way to preserve the casket and body in harmony with modern culture, is in the imperishable concrete vault where there can be no question about the seal.

The time is now ripe for marketing such a vault, for the general public are ready to depart from the repulsive customs of the past; and as the Automatic Sealing Vault perfectly fulfills every requirement and can be sold at a price within the reach of all, it provides the means for a large and lucrative business for concrete men. That the proposition is a "comer" is proved by the fact that the Automatic Sealing Vault Company has no difficulty in securing the support of practically all undertakers in the towns where they are represented, and also by the fact that they have been unable to secure the services of enough salesmen to take care of their inquiries.

They contract with but one man in a town, and give him control of all territory he can cover.

They are offering a particularly attractive side proposition for concrete machinery salesmen. Travelers who want extra money, and manufacturers who have a little spare time, should write the Automatic Sealing Vault Company, Peru, Indiana.

New York Cement Show, January 29-February 3, 1912.

Chicago Cement Show, February 21-28, 1912.

Kansas City Cement Show, March 14-31, 1912.

Bituminous Concrete Pavements*

By H. G. Lykken

To begin with I wish to define a Bituminous Concrete Pavement as a pavement composed of a compressed composition of crushed rock, sand and mineral dust aggregate with a binder of either coal tar pitch or asphalt cement, mechanically mixed before being spread on the roadway. While not considering the ordinary form of sheet asphalt pavement strictly a bituminous concrete, it may be considered under the same heading; for, after all, it is but an asphalt binder and a mineral aggregate somewhat finer than that in the regular concrete, yet otherwise the same. We may in one sense call a mixture of hydraulic cement and sand a concrete, as well as the mixture in which the aggregate is purposely coarser. In fact, our modern conception of a true concrete with its minimum voids in the aggregate, and all that, began with the sand and cement mortar of ancient origin to which more or less crushed stone and gravel aggregate was added.

I cannot help think of the analogy between a hydraulic cement and a bituminous cement concrete, and the development of both from the cement and sand mortar; only in the former no one thought of securing a patent on the gradation of the mineral aggregate. The evolution of the coarser mixture from the finer was analogous and inevitable in either case.

Little time can be given here to anything else but the surfacing material, but I wish to state in passing that, in my opinion, all composition pavements should have a Portland cement concrete or vitrified brick gutter of generous width. On slow grades, especially, it is a difficult matter to get a true gradient with a material that has to be compressed in place. If the gutters are built with Portland cement concrete or brick, laid true to line and grade, as they easily can be, a much better job can be had of the composition surface. But the chief advantage is the added life of the pavement. The best bituminous composition will deteriorate from action of the street fluids that accumulate along the gutter line, where the pavement is generally left porous from insufficient compression as the rollers cannot work close to the curb. Generally this becomes the weak point in the pavement which, with the other construction, forms a sanitary and easily cleaned surface.

The gutter should, however, be a part of the pavement area, and not a part of the curb built separate and distinct from the roadway proper. This is especially necessary where frost may cause a relative displacement of the curb and gutter, as I have seen in so many places.

It will be generally conceded, I take for granted, that a Portland cement concrete foundation is preferable to macadam, bituminous macadam or any other kind of base for a bituminous concrete pavement. Such a pavement must, above all things, have a uniform and rigid foundation. It must be uniform and laid to the correct contour of the finished street surface, as no raker can so gauge the thickness of his material that a dip will not form over every low spot in the base, as the thicker layers of the hot mixture compress more under the roller.

In the greater ease with which a uniform surface can be formed with concrete offsets, in the saving in the material of the bituminous surface and the labor of getting a smooth roadway, lies a considerable part of the possible difference of cost. Besides, lower prices of cement and the development of labor-saving mixing machinery makes a concrete base cheaper in most cases; in more cases, at least, than many users of macadam or bituminous macadam foundation realize.

In laying the concrete base for a bituminous pavement, I have always made it a practice to have the concrete fairly wet, so that it would compact with its own weight, or with slight tamping with the shovel. The finished surface of the base is left rough by drawing the edge of the shovel over it so as to bring the coarse aggregate to the surface. With properly graded gravel it is possible to produce a surface on which I would not hesitate to place even a sheet of asphalt pavement without the use of the binder course.

The object of the roughened surface is, of course, the same as the object of the binder course in sheet asphalt construction—to prevent any tendency of creeping.

Coming back to the surfacing material, I wish first to consider the mineral aggregate. As already stated, I consider it a natural evolution of composition pavements, such as sheet asphalt, to have substituted for the finer and inherently unstable aggregate one which is coarser, graded as to size and inherently stable. I mean here by stability, resistance to pressure and displacement by flow or creeping.

In a sand asphalt composition there is no resistance to pressure and flow as far as the aggregate or sand is concerned. The particles are all free to move but for the resistance offered by the cementing material, and the adhesiveness with which it connects the mineral particles must necessarily be the net resistance it can offer to the displacement of same.

In a graded aggregate where the size of the particles are to some extent commensurable with the thickness of the layer, an entirely different condition obtains. The aggregate itself will resist both pressure and lateral displacing forces. The cement serves to equalize the strains and adds to the resistance, but is relieved from possibility of excessive distortions and resulting weakening.

It seemed natural to add crushed rock to hydraulic cement mortar, and equally natural to develop an inherently stable aggregate as the modern conception of a good hydraulic concrete. It should seem equally natural to treat a bituminous mixture in the same manner. And as far as can be learned, the first attempt at making a bituminous concrete was by adding to the bituminous sand mortar or standard sheet asphalt mix the crushed rock with little consideration paid to its grading and sizing. The inherently stable aggregate came as a matter of course.

The doctrine of a stable aggregate, if it can be termed that, is finding a constantly wider acceptance, but there exists a greater diversity of opinion as to the proper size of the mineral particles. The earlier tendency was towards a coarser mix, up to two inches for the maximum size, as though the pendulum had swung from one extreme to the opposite in departing from the sand aggregate. Later much fine material has been used and considerable paving laid with a mixture grading from two mesh, and even less, as the maximum size.

Assuming that two inches is the proper and economical thickness for an asphalt concrete pavement sub-

*From a paper read before the American Society of Municipal Improvements.

ject to ordinary traffic, which is perhaps as nearly what it should be as has been determined to date, (for it must be thick enough to have a body of its own, aside and apart from the base, capable of resisting contraction strains, shocks and distortions, have depth so that the oxidation and gradual loss in elasticity, naturally going on in the surface layer will not appreciably reduce the total cohesion of the mass, and for proper manipulating in laying and rolling, yet not be too deep so as to waste material), we are left to determine the proper maximum size for such a thickness.

And here I consider results in the mechanical operation of raking or spreading the hot material on the street to take precedence over theoretical considerations. There is a pronounced tendency for the coarser particles to segregate in raking and drawing the layer down to the proper thickness. This is not so noticeable and is even entirely absent in a finer mix. I have gotten the best results with an aggregate grading from one and one-half mesh down. It may be that a slightly coarser aggregate, even one with the maximum size equivalent to half the depth of the finished layer could be used to advantage if properly put down, but under ordinary working conditions a mixture must be supplied which will insure a homogeneous pavement. The finer mix is more easily manipulated under the roller as well, making a smoother street and having less tendency to pit or show an open surface. The tendency to ravel and the larger stones in the aggregate to crush or loosen is also eliminated.

As this size of approximately one-third the depth of the pavement layer for the largest particles in the aggregate seems to be the largest size that will give the best results in the mechanical operation of laying it, I fail to see why larger stones should be used, and I do not think a coarser aggregate would make a more inherently stable mixture.

In grading the mineral aggregate, the same working conditions will limit the theoretical ideal mixture to what the commercial sizes of rock will afford. There is a limit to the number of screens that can be practically used on a mixing plant. While the maximum density of the finished product may always be in the engineer's mind, what he really gets in the long run under the best of conditions is a fairly well graded aggregate of rock particles with the voids filled with a mortar of sand, mineral dust and bituminous cement. That is really what all concretes are commercially, after all, and all that can be expected.

The rock should be hard, but more particularly tough in character, and should have a cubical fracture. If it comes from the crusher such that it ranges in size from one and one-half mesh, or the largest size specified, down to ten mesh, or with all passing a ten mesh eliminated, and in such manner that its mass density cannot be appreciably increased by addition of a quantity of intermediate screen, it can well be considered acceptable. The material screened out in passing the ten mesh screen and grading to impalpable dust, together with clean moderately sharp graded sand, whatever additional dust filler is necessary, and the bituminous cement will constitute the mortar. No hard and fast rule can be established for the proportions of the various ingredients in this mortar. The nature of the bituminous cement used, the sand, climate and traffic conditions, are all factors that must be considered. The finer rock screenings and sand dust must, of course, be used in quantities sufficient to give a certain volume and body to the mix, and the finer dust added in such proportions as to give the proper consistency or stiffness.

The finished pavement will have from 35 to 45 per cent by weight of this mortar, or a slight excess over that necessary to fill the voids. The pavement will be in effect a graded rock aggregate, not too coarse, but inherently stable and of hard, tough material, having all voids filled with the bituminous mortar; and having sufficient mortar in excess to close fairly well under the roller.

It goes without saying that a paving cement must be, first of all, stable and unaffected as far as possible by oxidation and the action of fluids met within the street. It must not be subject to disintegration by the temperature to which the rock may be heated in mixing, nor by the interaction or breaking up of its own component chemical combinations.

Within the range of temperature to which the pavement may be subjected, the cement must have a certain fixed cementing quality or adhesiveness, a certain quality of elongation in accommodating itself to contraction of the mineral aggregate due to temperature changes, or ductility, and a certain quality of plasticity usually referred to as penetration.

Motor Truck of Lake Erie Builders' Supply Co., Cleveland, Ohio.

But a certain factor of adhesiveness at a given temperature is not sufficient, as this quality varies greatly with the changes in temperature. Tests must be taken along the entire range to which the pavement will be subjected, and somewhat beyond both extremes. Such a series of tests could be represented by a curve, termed a curve of adhesiveness. Obviously the cement having a fair and fairly constant factor of adhesiveness would serve all purposes best in this one particular. The cement which at the highest and lowest temperature to which a pavement may be subjected loses that quality is evidently deficient.

There are on the market bituminous cements that at certain temperatures excel in this particular but which with a variation from this temperature diverge most extraordinarily. Many of them, while they may be used in the limited climatic range of some localities, become worthless under conditions where the range in temperature is wider.

In the same manner a curve of ductility covering the same range in temperature would reveal the possible behavior of the pavement under all conditions. A certain ductility at 77 degrees F. means nothing when one cement passing that test may be sufficiently ductile at zero and a range below, while another making an equally good showing will become more brittle than glass.

The ideal cement will have a fair factor of ductility (much is not necessary), but more important, a fairly constant one for all temperatures to which the pavement will be subjected. There are cements on the market having ductility to spare at the right temperature, which crack with the first chill.

A curve of penetration covering the same range of temperature would indicate the nature of the cement, not at certain ideal temperatures alone for that particular material, but at the most trying temperatures to the pavement, when it is too hot or too cold. The ideal cement would have a uniform factor of penetration for the entire range of temperature and not, as some cements on the market, a range from zero to infinity under actual working conditions.

In this connection I wish to submit that a simpler and better method of making the penetration test is to observe the length of time taken by a needle of a given size and given weight to penetrate, say, one centimeter, or any other convenient depth, into the material tested. The apparatus can be much simplified and will consist of a needle fixed to move in vertical guides and weighted with a weight constant for all tests. On the guides will be arranged a centimeter scale reading with a vernier. As the needle is released and after it has begun to penetrate the material, i. e., after it has penetrated the surface film, the zero reading is taken, and the time consumed in penetrating one centimeter, or any other convenient depth, noted. The time becomes the variable in this case and is easily and accurately determined. The penetration apparatus itself is very simple and capable of greater refinement in the test. The skin effect of some cements under certain temperatures is eliminated, as the penetration observed is that of the body of the cement alone.

To sum up: The paving cement should be stable, unaffected by oxidation, street fluids, the temperature used in mixing, chemical changes and interaction within itself. It should possess, throughout the entire range of temperature to which the pavement will be subjected, a fair degree of adhesiveness, that the particles of the mineral aggregate may be held in their relative position; a fair degree of ductility, that the pavement may accommodate itself to the expansion and contraction due to temperature changes; and a fairly uniform penetration, that the street may possess a uniform hardness and stability.

These requirements eliminate the various coal tar pitches and fluxes high in the paraffine scale and narrow down to the better grades of asphalt products. Thus a good bituminous concrete pavement must necessarily be an asphalt concrete pavement.

We have then a pavement consisting of a hard and tough rock aggregate, fine enough so that the larger particles will not segregate in the raking and spreading on the street and graded so as to be inherently stable, having all the voids and interstices filled with an asphalt, sand and dust mortar in such a manner that the rock particles are thoroughly imbedded and retained as well as cushioned in the matrix. Such a pavement will close fairly well under the roller and will need little if any surface dressing of the asphalt cement. It should have none smeared on the concrete base lest careless workmen put on an excess which will work up into the pavement and make it too soft.

The asphaltic mortar will have very much the same composition as a mix for standard sheet asphalt, except it will be richer in the cement, though the total mix will contain perceptibly less. The pavement will have all the advantages and desirable qualities of the sheet asphalt with its chief drawbacks—susceptibility to heat, softness, creeping and excessive wear—eliminated. With further improvement in the asphaltic cements, making them more adaptable to the wide range in temperature to which our pavements in the north are subjected, asphaltic concrete affords an ideal paving material.

I look upon bituminous concrete, or, as I should put it, asphalt concrete, as an improved form of the old asphalt pavement. It has been with us now long enough to prove its superiority. But because it partakes of a crushed stone aggregate, it need not go to the opposite extreme of being all stone graded to the elimination of voids except such as are to be filled with the bituminous cement. In this way it need not conflict with any patent rights, and is a far better pavement for not infringing or attempting to follow any patented formula.

The best pavement will have a rock aggregate with the voids ranging from 30 to 35 per cent which are filled with the asphaltic mortar. Such a pavement will have all the stability necessary, yet have a quality of elasticity that adds materially to its life and wear. It will naturally take a little more cement or bitumen which, however, I consider a virtue, as the extra amount remains in store in the pavement replacing the natural loss due to oxidation and other possible causes.

FERRO-CEMENT ROADS.

"Ferro-cement" roads are being experimented with in France. The substance is made of cement mixed with iron straw. To make a slab or block of ferro-cement, a mass of iron-straw is placed in the mold, and there is poured over it cement sufficiently fluid to penetrate into all the interstices of the iron and completely cover it. When the whole has set, the core of iron thus intimately incorporated gives to the block a great resistance to breakage and to traction, at the same time furnishing elasticity to compression which enables it to stand superficial shocks. A brick of ferro-cement 1 3/5 inches thick has supported during crushing tests, a pressure of about 65 tons to the square inch. In breakage tests, the resistance was quadruple that of ordinary cement. Resistance to wear was no less remarkable.

PROFITS IN MODERN BLOCK WORK.

By H. F. Hobbs.

If the concrete block manufacturer wants to prosper, he must secure for his product the indorsement of architects and builders. To accomplish this, he must not only make a hard, waterproof block, but he must produce a block that will be pleasing to the eye and be conformable to the general scheme of architectural design.

Plain-faced blocks are apt to be cold and uninteresting in appearance, and that is why many people prefer rock-faced work. The rock-faced block, as frequently made, however, is simply intolerable from an artistic or aesthetic standpoint.

This is owing to the use of cast-iron rock-face plates, and to the use of one size and style of block only in an entire building. It is practically impossible for cast-iron rock-face plates to produce a natural rock face. It requires a more plastic material, with which a cast can be taken directly from the natural stone, and then the block tamped face-down on the cast. This cast can be taken even with plaster of Paris, but a composition that is hard and durable is more desirable. Rock-faced block made in this manner go far toward giving natural and pleasing effects. The grain and outline of the pattern stone are not lost, and the result is fine indeed.

If the block so made are laid in alternate courses of different height, or—better still—laid in real broken ashlar, the effect is so much better than the common, monotonous, and artificial looking block work, that the comparison is startling. It must be seen to be fully appreciated. The above cut illustrates real broken ashlar block work made from composition face-plates. Blocks 4, 8 and 12 inches high, and from 4 to 24 inches long, are used. The 4-inch and the 8-inch high blocks bond with the 12-inch high block, and produce a very strong wall.

If one is properly equipped to do this work, it need cost no more than common work. It will cost, however, about 10 to 15 per cent more to lay.

On the other hand, the block manufacturer will find that this work will please and attract the architects and the best people, and it has been proven that, although produced at only a slight increase in cost over common work, it sells readily for 100 per cent more.

When this broken ashlar work is made and laid carefully, it presents an appearance equal to that of the finest stone masonry. In California, many of the finest churches have been built in this manner.

The progressive block manufacturer in each community who first makes his block on composition plates, and then lays them in real broken ashlar, it is claimed by the advocates of this system, has every chance to reap prosperity beyond his highest expectations.

When broken ashlar becomes better known, it is sure to be popular, and let us hope it will soon displace the unsightly work that has nearly brought concrete block work into disrepute.

REAL BROKEN ASHLAR.

Blocks Made from Composition Face-Plates, Manufactured by Hobbs Concrete Machinery Co., Detroit, Mich.

ROCK CRUSHING ON CHICAGO STREETS.

Portable rock crushers have been used for many years in crushing field stone for macadam roads. Something the same principle has recently been applied to paving work in the City of Chicago. On streets where the old granite block pavement was being replaced with creosoted wood blocks laid on a concrete base, the old granite blocks were crushed at the site of the work by means of a crusher mounted on trucks. The resulting broken stone was then used in the concrete base for the new pavement. A No. 3 "Reliance" crusher, manufactured by the Universal Road Machinery Co., of Kingston, N. Y., was used. This crusher was mounted on a truck having a turntable, and operated by a belt from a road roller, which also furnished the means of moving the outfit.

MANUFACTURERS OF SAND-LIME-BRICK PRODUCTS CLOSE CONVENTION.

Officers elected by the American Association of Manufacturers of Sand-Lime-Brick products at its annual session in the Pantlind Hotel, Grand Rapids, Mich.:

President, S. O. Goho, Harrisburg, Pa.; vice-president, W. D. Schultz, Bradford, Ont.; secretary, W. E. Plummer, Buffalo; treasurer, John L. Jackson, Saginaw, Mich. Executive committee, eastern district: G. W. Lowenthal, Rockaway, N. J.; southern district, H. W. D. Skeel, Savannah, Ga.; central district, L. W. Penfield, Willoughby, O.; western district, E. G. Chapman, Minneapolis; Canada, F. B. Allen, Toronto.

The next convention will be held in Toronto, December 3 and 4, 1912.

Austin Crushers

The Austin Manufacturing Company has designed and placed on the market during the past year a No. 10 size of gyratory crusher. This machine weighs 175,000 pounds and is constructed along the same lines as the well-known Austin crushers of less capacity, being the same in every respect excepting as to weight, dimensions and capacity.

In the No. 10 machine we understand are embodied the pronounced features of advantage that have always made the Austin crusher so distinguished since its first appearance in the field. These features were both original and unique as applied to gyratory crushers at the time of their inception. They are the result of practical experience and years of careful study and were especially intended to overcome and correct faults in design and weaknesses machines of this kind where known to possess.

That these are real improvements and recognized as such by the users of this class of machinery is attested to by the large number of Austin crushers to be found in use, for they are extensively employed wherever stone and ore is being broken.

The Austin No. 10 has two spider receiving openings, measuring 25 by 72 inches each. It is intended to take in and break pieces of rock twenty-four inches in thickness. This size of crusher, we understand, is always fitted with cast steel spider and cast steel bevel pinion and driving gear. It has a capacity of from 250 to 450 tons per hour; the exact output is determined by the character of material and the size to which it is reduced.

That the Austin crusher is not only popular among quarrymen and contractors, but equally as well thought of in other industries in which such machines are employed, we are printing below the names and addresses of a few of the many prominent cement mills in which the Austin crushers are used.

Ironton Portland Cement Co., Ironton, Ohio, No. 5 and No. 2.

Midland Portland Cement Co., Indianapolis, Ind., one No. 3.

California Portland Cement Co., Los Angeles, Calif., No. 3 and No. 6.

Lehigh Portland Cement Co., Allentown, Pa., No. 3 and four No. 5's.

Alamo Cement Co., San Antonio, Texas, one No. 3.

Mississippi Valley Portland Cement Co., Louisiana, Mo., No. 5.

Bath Portland Cement Co., Easton, Pa., No. 2 and two No. 6 crushers.

Indian Head Portland Cement Co., Neodesha, Kans., one No. 6.

Ashland Cement & Construction Co., Ashland, Ky., No. 2.

Reliance Cement Co., Philadelphia, Pa., No. 2 and No. 6.

Kansas Portland Cement Co., Iola, Kans., No. 8 and two No. 5's.

Crescent Cement Co., Charlestown, Ind., one No. 5.

Elk Cement & Lime Co., Petoskey, Mich., No. 8 and two No. 5's.

Chicago Portland Cement Co., Chicago, Ill., No. 7½.

Illinois Hydraulic Cement Co., Utica, Ill., No. 5.

Cayuga Lake Cement Co., Ithaca, N. Y., one No. 5.

U. S. Portland Cement Co., Bedford, Ind., two No. 6 crushers.

Fordwick Company, Fordwick, Va., one No. 3 and two No. 7½ crushers.

Southern California Cement Co., Riverside, Calif., one No. 8 and two No. 4's.

Kansas City Portland Cement Co., Kansas City, Mo., No. 7½.

Alsen's American Portland Cement Co., Alsen, N. Y., No. 8.

Newcastle Portland Cement Co., Newcastle, Pa., two No. 8's and two No. 6's.

Chanute Cement & Clay Products Co., Chanute, Kans., one No. 8 and two No. 5 crushers, with elevators, screens, etc.

Lehigh Portland Cement Co., Allentown, Pa., No. 5.

Canadian Portland Cement Co., Port Colborne, Ont., two No. 5 plants.

Altoona Portland Cement Co., Altoona, Kans., No. 6 crusher.

We are pleased to publish below a technical statement covering the advantages of the machine as set forth in the printed matter of its manufacturers, which it seems are responsible for the wide and growing popularity the Austin crusher has gained.

First, the Austin is the only gyratory crusher on which the crushing strain is not carried on the bottom plate of the machine. In the Austin design they transfer this enormous load from the bottom plate to the main frame of the crusher, the heaviest, strongest and most rigid part of the entire crusher, while in all other gyratory crushers this tremendous strain is put on the bottom plate, which is held to the main frame with bolts.

Secondly, the Austin is the only gyratory crusher on which the countershaft carrying the bevel pinion has a double support, or in which the countershaft has a support on both sides of the bevel pinion. On all other gyratory crushers the bevel pinion runs in what is termed in mechanics as an "overhanging" bearing and which all competent mechanical engineers consider good practice to avoid whenever possible.

Thirdly, the Austin is the only gyratory crusher which is equipped with an automatic oiling or lubricating system. The Austin crusher is provided with an oil pump which is connected to the main shaft; therefore, whenever the crusher is in operation the pump keeps a constant flow of live oil through the bearings of the machine. Inasmuch as these bearings are subjected to an enormous load, those familiar with these machines will readily appreciate the great importance of perfect lubrication.

Fourthly, with the Austin construction the feature of zincing the head to the main shaft is eliminated. The main shaft on the outside and the head on the inside are machine turned to correspondence tapers, so that they are a perfect fit. There is a large feathered steel key in the main shaft and a keyway on the inside of the head to correspond, which prevents the head from turning on the shaft. The lock nut on top of the head holds the head down tight and in place; therefore, when necessary to change the head all that is required is simply to take off the lock nut and the head can readily be separated from the shaft.

FACTORIES AND WAREHOUSES OF CONCRETE.

Under the above mentioned title a book has been published by the Association of American Portland Cement Manufacturers, illustrating 235 factory buildings of all classes and sizes, representing about 200 different industries. The advantages in ultimate cost, sanitary qualities and fire resistance are fully pointed out and will not fail to attract architects and builders. Cement and Engineering News will forward postpaid copy upon receipt of 50 cents.

PAINTING OVER CEMENT OR CONCRETE.

This is a foremost subject with painters today because of the amount of such work that calls for painting. From the number of inquiries received concerning what to do with such work, it is evident that considerable misunderstanding prevails among painters as to the proper procedure.

To make the matter clear, it may be stated that paint applied to cement that has not stood long enough to become weathered is unsafe to paint over. Therefore the thing to do is to let it stand from six months to a year, the latter being better. Eighteen months is better still. The cause of the trouble is found in the alkali in the cement, which kills the oil in the paint. We have heard of cement being painted over after the lapse of only four months, using white lead paint, and the job turned out all right; but this is an exception to a rule. We do not know why this case succeeded.

If the surface must be painted sooner, or even at once, then the thing to do is to kill the alkali, and this has been objected to by some experts, who claim that it hurts the cement. I see that carbonic acid water is now advised for this purpose. It can be bought in siphons, I hear. The stuff is applied by means of a brush, or can be sprayed on. The carbonic gas kills the alkali, just as the same gas in the air does in a much slower way. As soon as the surface is well dried out the paint may be applied.

Another method calls for the application of zinc sulphate, an inexpensive article that may be bought at any drug store. Use 10 parts zinc sulphate to 90 parts water. This is a very useful substance for treating plaster walls when badly stained with water stains.

But why paint cement or concrete? To protect it? Not especially, but to make it look better. That is one bad feature of cement; it assumes a very unpleasing appearance in time, and if some genius will kindly step to the front with a plan for making cement look good after months and years of exposure he shall not miss his reward. True, there are special colorless preparations or "finishes" for preserving both the integrity of the cement and its proper appearance. That would seem to be better than paint, which does destroy the natural appearance of cement work.

The following have been given as correct formulae for painting on cement or concrete:

Priming Coat—100 pounds pure white lead, 9 gallons pure kettle boiled linseed oil (or in place of that use 9 gallons pure raw linseed oil and three half-pints of turpentine driers) and 1 gallon turpentine.

Body Coat—100 pounds pure white lead, 4 gallons pure linseed oil (1-3 boiled and 2-3 raw) or 4 gallons pure raw linseed oil and 1 pint turpentine drier.

Finishing Coat—100 pounds pure white lead, 3½ gallons pure linseed oil (1-3 boiled and 2-3 raw, or 3½ gallons pure raw linseed oil and 1 pint turpentine drier), and 1 pint pure gum turpentine.

Notice that all the ingredients are to be the best of the kind. Zinc white is thought to be too hard for cement painting. Some painters preferred red lead for the priming coat, using the formula: 85 pounds pure dry red lead. 1 gallon pure kettle boiled linseed oil and ¼ gallon turpentine. Red lead makes a more nearly impervious coating than white lead, and is also quite elastic. But the red is objectionable where light colors are to be used in the finishing coat, unless a good body coat is applied over the red lead paint, followed by a good finishing coat. Even then I believe there would be danger of the red affecting the finish color in time.

HOTEL KIMBALL,
Springfield, Mass.
Cast Concrete Stone Trim—Concrete Floors and Fireproofing.

The Pittsburg Testing Laboratory, Pittsburg, has moved into a new five-story office and laboratory building at Seventh and Bedford avenues, Pittsburg, Pa. The building, owned by the laboratory, is said to be the largest plant of its kind in the world.

CONSTRUCTION METHODS ON A CONCRETE PAPER MILL AND DAM.

In erecting the reinforced concrete paper mill, dam, forebays and flumes for the Cabot Mfg. Co. at Topsham, Me., the Aberthaw Construction Co. of Boston employed some interesting construction methods. The mill, which is located on the Androscoggin river about a mile from Brunswick and has been leased to the Pejepscott Paper Mill for a long term of years, was designed primarily to utilize the waste flow of water during the periods when the river is high and at night time. The old plant, located on the west bank of the river, uses a timber dam closing off the flow between two high rock abutments that here border the stream and the new development has provided a passage for the water behind the rock abutment on the east bank.

In the execution of this work it was found necessary to erect two coffer dams at different levels, enclosing about 160,000,000 square yards. The river bed is of solid granite. About 4,223 yards of rock were excavated and the Aberthaw Construction Co. conducted the work in such a manner that the stone as blasted was crushed and used in the concrete work, thereby eliminating the necessity of bringing the stone to another source.

The construction plant, in general, may be said to have consisted of one derrick located at the point of excavation and one at the stone crusher, both connected to the industrial tracks running on trestles which were shifted in accordance with the location of the blasting. The former derrick lifted the skips filled with rock onto flat cars, while the latter took them off and dumped them in the pile from which the stone reached the crusher by a conveyor. Below the crusher was the concrete mixer, discharging into cars that were carried to the various points of work on an industrial track.

The dam, of the sectional ogee type, extends from a ledge in the river to an abutment on the river side of the mill and is constructed of concrete of proportions 1:2½:5 with 30 per cent of the excavated rock embedded, and is 135 feet long, 27 feet wide at the base and 7 feet 5½ inches wide at the top, which is 20 feet above tail water elevation. The upstream face is vertical; the downstream face forms an angle of about 32 degrees with the perpendicular, and with an 8-foot arc is swung into the horizontal upper edge of the toe, which, like the upstream face, is keyed into the solid rock. As the slope of the ledge is generally about 30 degrees, the height of the dam increases as it approaches the abutment, the top of which is 12 feet above the crest of the dam and about 51 feet from the bottom of the river on the tail race side of the mill.

The wing retaining wall, located on the shore side of the mill, is about 85 feet long and its top is at the same elevation as the abutment. It is of the cantilever type and as it extends towards the rising shore its height, width and general dimensions decrease proportionally. At its largest section the base, which is set about three feet in the rock, is 16 feet wide, while at the smallest it is 10 feet. In the vertical face there is reinforcing by one-half inch square bars, the spacing increasing from 4 inches at the bottom to 12 inches at the top in the highest section, and from 7 inches to 12 inches in the lowest. The bars are set two inches below the outer surface. In the base similarly placed reinforcing consists of ⅞-inch bars generally twelve inches on centers.

The fill in back of this retaining wall consists of about 3,000 yards of silt which, by an ingenious hydraulic sluicing arrangement was brought from the river bed up the stream and then carefully puddled and tamped. A 50-foot derrick with an orange peel bucket raised the earth from the river bed to a slanting hopper located on a wooden tower about 25 feet high. Discharging horizontally against this slanting face were about twelve 2-inch water pipes, all connected to a 6-inch supply, which ran across and above the hopper and connected with a motor driven centrifugal pump located on the ground directly beside the tower, and with a 6-inch suction to the river. The hopper opened into the sluice, down which the silt was carried by gravity to the front of the retaining wall. The cost of this fill, exclusive of the cost of the plant, was nine cents per yard. The outlay on the plant was $630 and this would have been the same if the fill had been many times larger instead of only about 650 yards.

The mill itself is a building 116½ feet by 112 feet 8 inches, and with the exception of the one-story brick superstructure, is entirely of reinforced concrete of proportions generally 1:2:4. The head gate platform in front of the mill is 32 feet by 113 feet, with the gates ahead of the racks, which are protected by a concrete fender wall 23 feet deep. There are five flumes in all. Four of these have two gates each, with openings 8½ feet by 14½ feet, and are 59 feet long by 20 feet wide and 15 feet deep. The fifth flume is 127 feet long, of the same section, but has three gates. Each forebay is about 19 feet wide and 32 feet deep.

A railroad siding has been constructed from the Lewiston branch of the Maine Central railroad to the mill, a distance of 3,000 feet. This siding extends somewhat beyond the mill and will be used not only for the pulp mill, but the teams from the paper mill in the future will haul to and from this siding instead of making the long haul to the Brunswick freight yards, thus effecting a large saving in time and teams.

This work was designed by I. W. Jones, engineer, of Milton, N. H. The inspector was Freeman R. Preble. With the exception of the superstructure of brick, erected by Charles E. Hacher of Brunswick, the entire contract was executed by the Aberthaw Construction Co. of Boston, Mass.

RAILROAD CONTRACTS TO ERECT FORTY DWELLINGS OF POURED CONCRETE.

The Delaware, Lackawanna & Western railroad has contracted for forty model dwellings of poured concrete, near Scranton, Pa. A whole village of these new types of homes is to be erected for the operatives of the anthracite mines.

The railroad company, before adopting the poured houses, made investigation of all model systems of home building and chose the poured house because it affords a fireproof, sanitary structure, cool in summer and warm in winter, and can be built at the cost of a frame house.

This new cement town will be constructed by a novel system. A railroad track will be laid around the group of buildings. A mixing plant will be mounted upon a flatcar, with an elevator for hoisting concrete into the steel forms placed around the walls and partitions. A carload of cement, sand and cinders will be attached to the mining train, and the train will move from house to house as the pouring progresses. The mixture of cinders, sand and cement employs the waste product from the burned culm piles which adjoin the mines.

In the center of the group of buildings will be a lawn 600 feet in length. Adjoining this group of dwellings and on a high plateau will be a group of bungalows for the superintendent of the mines and his assistants.

STONE SMASHES RECORDS.

Over Seventy-Five Million Dollars' Worth Produced in 1910, According to the United States Geological Survey.

The value of the production of the stone quarries of the United States during 1910 was the largest in the history of the industry and was more than double that of 1900, the figures being respectively $76,520,584 and $36,970,777. The output for 1910, according to Ernest F. Burchard, of the United States Geological Survey, shows an increase over that of 1909 of $5,175,385, or more than 7 per cent. The increase in stone production of all the principal sorts has been notable during the last few years, as is shown by the following statement, all the classes having heavily increased except bluestone.

Value of different kinds of stone produced in the United States, 1900-1910:

	1900	1905	1910
Granite	$10,969,417	$17,563,139	$20,541,967
Trap rock	1,706,200	3,074,554	6,452,141
Sandstone	5,272,865	8,075,149	6,394,832
Bluestone	1,198,519	1,931,625	1,535,187
Marble	4,267,253	7,129,071	6,992,779
Limestone	13,556,523	26,025,210	34,603,678
	$36,970,777	$63,798,748	$76,520,584

Pennsylvania was the greatest stone producer in 1910, with an output valued at the quarries, of $8,621,-937; New York was second, with $6,410,688; Vermont third, $6,282,574; Ohio fourth, $5,759,563; Indiana fifth, $4,476,382; California sixth, $4,292,451; Illinois seventh, $3,853,425; and Massachusetts eighth, $3,013,375. Twenty-four states produced stone to the value of $1,000,000 or more.

For use in road making 18,085,170 short tons of crushed stone was produced, valued at $11,911,246, a slight decrease in both quantity and value compared with the figures for 1909. For use in making concrete the production of crushed stone in 1909 and 1910 was 11,001,611 tons (value, $7,011,150) and 13,967,940 tons (value, $8,957,098), respectively.

The statistics of stone are shown in an advance chapter from "Mineral Resources" for 1910 just issued by the United States Geological Survey. The subject is reported in considerable detail by states for all classes of stone. A copy of the report may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

CEMENT TESTING ORDINANCE.

After several weeks of indecision, the Los Angeles city council this week decided to amend the cement testing provision, Sec. 176, of the city building ordinance, to conform in most features with the recommendations of the cement manufacturers, who were backed in their demands by a number of architects, engineers and builders. The council some time ago changed the specifications regarding the amount from which the samples should be taken, making the quantity two hundred barrels instead of ten barrels from which a complete test should be taken, a portion of the sample to be drawn from every tenth barrel, and when properly mixed this shall constitute a sample. This was one of the points which it was claimed resulted in unnecessary expense.

Another feature also strenuously opposed was the proposed provision that "the cement shall be stored at the mill or on the work, or partially at both, for thirty days," which would, it was charged, not only greatly delay the work, but would cause heavy expense on the part of the mills in storage facilities, or compel the contractor to tie his money up in cement for thirty days, storing the cement in weather-tight quarters on the job in excessively large quantities if he wanted to guarantee himself a sufficient amount of tested cement to keep the work going in proper manner. This provision is to be changed to require only a seven-day test in the case of cements that have been used locally for at least a year and their qualities known; the cement to be rejected unconditionally if it fails under this test, without consideration as to how it might act on the twenty-eight-day test. This change will require the storage of cement only twelve instead of the contemplated twenty-eight days.

Cement testing under the ordinance will apply only to reinforced concrete work, fire proofing, tile floor construction and for finish. It will not apply to street work or plain concrete. It will also be made a part of the ordinance that cements new on this market will not be allowed to pass on the seven-day test until they have been used locally for the period of one year.

The council, after making its final decision, remanded the section back to the legislative committee for redrafting along the lines decided upon, and it will be some time before it can be made effective.

DANISH PEBBLES FOR CEMENT GRINDING.

Flint pebbles are found along the coasts of certain Danish islands, where they have been thrown up by the force of the waves and buried in the so-called "mines," which are old deposits of stones and sand along the shore. These collections have been forming for centuries, and the pebbles are now found amongst enormous quantities of said and other stones. Men are employed to dig these pebbles from the mines, where they lie from 12 to 16 feet deep. From this debris, all the pebbles of commercial value, having a greatest diameter of from 1 to 5½ inches, and of shape conforming to the standard given, are carefully selected. From this it will be seen that an exporter's stock of flint pebbles is composed of all the sizes marketable. The stones are sold just as they are taken from the mines, exactly as the constant action of the waves has shaped them.

The pebble mines, as described in a recent report from Wallace C. Bond, United States Consul at Copenhagen, are worked by gangs of 3 to 16 men; and the pebbles dug are collected at various depths along the coast, whence they are shipped by boat to the wholesalers' yards at Copenhagen, where they are carefully assorted according to quality and size.

Sizes 2, 3 and 4 inches are in most demand; and if a firm in the United States should place an order for 2,000 tons annually of one of these sizes—say, the most popular one—there would be an increase in its price, for the reason that in order to get 2,000 tons of this one size, 8,000 tons of other sizes would have to be mined. On the other hand, if orders were for 2,000 tons of mixed sizes—say, of 2, 3 and 4, or of 3, 4 and 5 inches—there would be no increase in the present prices. The supply in the mines is ample to meet an increased demand of 2,000 tons or more. The only difficulty would be in finding a market for the extra pebbles in case 2,000 tons of one size were delivered annually to one importer.

The contract for the concrete piles and foundations of a building to be erected at Louisville, Ky., for the Kentucky Elevator Company, has been awarded to the Raymond Concrete Pile Company, of New York and Chicago; Witherspool & Englar, engineers.

UNIQUE DESIGN OF CONTROLLABLE DUMPING BUCKET MADE ESPECIALLY FOR PLACING CONCRETE IN THIN WALLS.

In the construction of concrete work, contractors have often found it difficult with the ordinary drop bottom bucket to place concrete in thin walls, as most of these buckets on the market have uniformly sloping sides or the dumping mechanism is located on the front or discharge side where its operation is often interfered with by the reinforcement rods or forms.

With the idea of overcoming this difficulty a drop bottom bucket has been designed, the section of which is a right-angle triangle, the front or discharge side being vertical. It is evident by this arrangement that there is no interference from the steel reinforcement rods or forms in the operation of the bucket mechanism.

The construction of this bucket is very simple. The drop bottom, which is slightly curved, is about one-fourth of the length of the sloping side. It is operated by a handle on the end of which is a cam bearing on an equal arm lever that connects through another lever to the drop bottom. The discharge of the concrete is readily controlled by the operator, who can let the concrete out in small or large quantities. In cases where thin layers of concrete are desired the operator can control the discharge and move the bucket forward or backward, as desired, thus spreading the mass. The shape of the drop bottom is such that with a little experience the operator can throw the concrete through a steel system from four to six feet wide.

This new bucket, while it was primarily designed for thin wall construction, discharging concrete readily in narrow forms for walls only three inches thick, without any waste of concrete or any extra handling, will be generally useful in all kinds of concrete work and the shape of this bucket is such that very little scraping is needed after the batch is let out. The vertical face gives a clear fall to the batch of concrete, which draws the concrete down with such force that a scowing is produced on the sloping side and the bucket is cleaned completely. This is a point which means a great saving of time and also saves the bucket from the hammering commonly needed to clean so many buckets on the market.

It has been used with much success by contractors J. B. Smith Co. in erecting the inclined reinforced concrete abutments for the overhead double track crossing on the Western and Atlantic railway at McCarty, Tenn.

The bucket is now fully protected by patents and has just been put on the market by the manufacturers, Ransome Concrete Machinery Co., Dunellen, N. J.

TWELVE MILES OF CONCRETE PIPE.

Twelve miles of 36-inch concrete pipe have been constructed down a canyon on the east slope of the Rocky mountains, in Colorado, to convey water to the hydroelectric power plant of the Eastern Colorado Power Co. The line extends from a concrete masonry dam across a stream 8,000 feet above sea level to the power house near Boulder, the grade having a fall of approximately 26 feet to the mile.

The construction of this pipe line was unusually difficult, a large percentage of the excavation being through solid rock. Rocky hills, jutting out here and there into the canyon in such manner as to make the cutting of a trench impracticable, had to be tunneled. Seven tunnels, having a total length of 1,500 feet, had to be pierced through the rock.

HAROLD WALKER RESIDENCE,
Denver, Colo.
Covered With Pure White Medusa Portland Cement.

REINFORCED CONCRETE COAL BUNKERS.

A large plant in Waldhof has built a reinforced concrete coal storage plant or pocket for a capacity of 1,030 cbm. (36,050 cu. ft.). The hoppers are filled and emptied mechanically. The silo rests on 12 reinforced concrete columns 40x105 cm. (16x42 in.) cross section, 5.2 m. (19 ft.) high and 4.4 m. (15 ft.) between every two columns. The weight of the coal was computed at 850 kg/cbm. (54 lbs./cu. ft.). Wind pressure was computed at 125 kg. sq. m. (25 lbs./sq. ft.). The total length of the bunkers is 24.3 m. (80 ft.), the width 6.5 m. (21.2 ft.) and the height is 20 m. (66 ft.). Below these bunkers, i. e. between the columns, are the boilers and furnaces which furnish the power for the plant, and the hoppers discharge coal directly into the latter from the bunkers. The thickness of the silo walls is 8.5 cm. (3.4 in.) at the top and 17.5 cm. (7 in.) near the base, where the hoppers begin. The silo is roofed by a reinforced concrete arched roof of 5.5 m. (18 ft.) span, 6 cm. (2.4 in.) thick at the crown and 8 cm. (3.2 in.) thick at the skewback. The inner surfaces of the silo and hopper are finished with a cement finish 1:2.—*Armierter Beton.*

WEALTH IN SAND AND GRAVEL.

Great Increase in Production in 1910, According to United States Geological Survey.

More than $21,000,000 worth of sand and gravel was dug for sale in the United States in 1910. This is a figure not many million dollars removed from our present annual production of silver. According to a report by Ernest F. Burchard just issued by the United States Geological Survey, the production of glass sand, other sand, and gravel in 1910, was 69,410,436 short tons, valued at $21,037,630, against 59,565,551 short tons, valued at $18,336,990, for 1909.

This increase in production of nearly 10,000,000 short tons and in value of over $2,700,000 is due to the more extensive use of sand and gravel in concrete construction work, building sand constituting nearly half of the entire output of the year. During recent years, particularly in the large building centers, there has been a greater general appreciation of the importance of using proper sand and gravel in cement concrete, so that leading architects and builders are requiring sound, clean, washed material.

Tests of Material for Federal Buildings.

The Geological Survey formerly made field and laboratory studies of many kinds of sands and gravels in localities where Federal buildings were in course of construction. These studies have shown great variations in the quality of sand and gravel used at different places for making concrete. Some contractors contend that run-of-bank sand and gravel are the best for making concrete, but this contention is generally not sustained by practical trials and experiments. The most desirable material is that which is free from clay, loam, or dust. Mica, pyrite, or limonite also is objectionable, if present in large quantity. A coating of dust on gravel prevents its proper contact with cement, so that such pebbles are easily broken out of the concrete.

The following table shows the tremendous increase in production of sand and gravel in the last nine years, which is largely coincident with the growth of the cement industry in the same period, cement production having increased from 25,274,949 barrels in 1902 to 77,785,141 barrels in 1910.

Sand and gravel produced in the United States, 1902-1910, *in short tons.*

Years.	Quantity.	Value.
1902	1,847,901	[1]$1,423,614
1903	2,110,660	[1]1,831,210
1904	10,679,728	[1]5,748,099
1905	23,204,967	11,223,645
1906	32,932,002	12,698,208
1907	41,851,918	14,492,069
1908	37,216,044	13,270,032
1909	59,565,551	18,336,990
1910	69,410,436	21,037,630

[1]Includes only a very small quantity of gravel.

A copy of Mr. Burchard's report may be obtained by applying to the director of the Geological Survey, Washington, D. C.

The Raymond Concrete Pile Co., of New York and Chicago, has been awarded the contract for the concrete piles and foundations of a bakery building to be erected at Eleventh avenue and South Pierce street, Milwaukee; Foster Construction Co., general contractors.

ACTION OF SOME LIQUIDS ON CEMENT AND CONCRETE.

Sugar Solutions and Syrup.—Pieces of concrete were placed into a glass jar and covered with a 20 per cent pure sugar solution and left there for three months under occasional stirring. After a few days a white flocculent sediment appeared on the surface of the concrete which fell off. After about three months, the entire solution had a dark brown color and contained a brown deposit. Analysis showed that aluminum oxide, iron and lime had gone into solution. The structure of concrete was loosened, proving that concrete vats should be used carefully for a sugar solution.

Glycerine shows the same results, though somewhat weaker. Iron oxide did not dissolve, but aluminum oxides dissolved in large quantities.

Gas and Ammonia Waters.—Ammonium sulphate and ammonium carbonate as well as ammonia liquor have an injurious influence on concrete. The ammonia colors the concrete a dark color, and the ammonia sulphate forms iron sulphide and takes on a grayish black color. As long as the concrete is completely covered with the liquid the structure is not destroyed. Ammonium carbonate causes no visible mechanical changes and the chemical analysis of the solution gave traces of iron only. As long as cement tanks are always filled with these liquors they can be used without trouble. But if they come in contact with the air and then again with the ammonia liquor the soluble iron sulphate is formed with resulting destruction of the concrete tank. —*Zentralblatt fur Hydraulische Zemente.*

HEADQUARTERS IN KANSAS CITY.

The headquarters of the cement merger, with a capital stock of $50,000,000, will be in Kansas City if the plan to merge the twenty independent plants west of the Mississippi river succeeds. The deal probably will go through in the next few days. At a meeting in the Hotel Baltimore, representatives of all except one of the twenty plants agreed on a plan for organization. It was agreed that if the plants are to merge they shall go into one corporation by the end of this month or not at all.

The owners of the steel industries in the East are said to be interested in the plan. The American Appraisal Company of Milwaukee has finished appraising the different plants in Missouri, Kansas and Oklahoma that are to be absorbed. The owners of stock in the independent companies are to take 50 per cent in stock and 50 per cent in 6 per cent bonds of the new company. Such securities will be pro-rated according to the value of the plants as appraised by the Milwaukee company. The charter of the new company is to be drawn to comply with the anti-trust laws.

NEWS ITEMS.

August Eggers, Blue Grass, Iowa, has just started a factory to manufacture concrete blocks.

The Bluffton Cement Products Co., Bluffton, Ind., are erecting a one-story addition to their block and tile factory.

Edward Cooney has purchased a new cement block machine, mixer and automatic tamper and expect to enlarge his concrete block factory at Peoria, Ill.

Dr. Marlow, Geo. P. Walker and John Drinkwater have purchased a site on which they will erect a factory for the manufacture of cement posts.

CLINKER CONCRETE IS TESTED AT MARQUETTE UNIVERSITY.

Some interesting tests have been made recently of concrete and reinforced concrete at Marquette University by Dean Swift of the Engineering School and some of the students and a report of the work is given in *Marquette University Journal* as follows:

The material for these tests was Huron Portland cement furnished by the Western Lime & Cement Co.; clinker from the Milwaukee Incinerator, furnished by S. E. Greeley and gravel from the J. C. James gravel pits. The cement had been tested in the regular laboratory and met all standard specifications. The gravel was fine and clean and for test purposes it was screened through one-eighth-inch screen; that passing through being called sand and the remainder called gravel. The clinker is the product from the furnaces at the new garbage incinerator and results from the burnings of a mixture of garbage, refuse and ashes. It is a surprisingly hard and strong product and very rough. It looks exactly like the clinker from any furnace, but it is not mixed with the ashes. This is due to the particular method employed in burning. Ordinary cinder concrete is supposed to average about one-third the strength of gravel concrete but this clinker concrete was better than the gravel concrete made in our laboratory.

When the tests were started it was the intention to investigate the strength of reinforced clinker concrete as compared with reinforced gravel concrete. Four clinker concrete beams, with a mixture of one part cement, two parts sand and four parts clinker were made and tested in the 50,000 pound testing machine in the engineering laboratory. Three of these were reinforced with a one-half-inch Kahn bar and one with four three-eighth-inch plain round bars. Each one was nine and one-half inches high by six inches wide and the steel placed one and one-half inches from the bottom. Two gravel concrete beams of a 1:2:4 mixture were made so as to compare the clinker beams with a standard material. Each of these was reinforced with one one-half-inch Kahn bar and were nine and one-half inches deep. One was six inches and the other seven inches in width. All the beams reinforced with a Kahn bar failed by compression of the concrete under a central load of about 4,000 lbs. the span in all cases being ten feet. It was very noticeable during the application of the load that the deflection of the beam varied directly with load up to the point of failure. Even after the beam showed failure the load remained equal to the breaking load for a deflection of about two inches. During the application of the load to the beam reinforced with plain round rods it acted similarly to the other up to a larger load of 5,000 lbs. when the large crack appeared suddenly.

The table shows a summary of the beam tests:

Material.	Maximum load.
No. 1 gravel	4370
No. 2 clinker	3500
No. 3 clinker	3480
No. 4 clinker	4200
No. 5 clinker	5100
No. 6 gravel	4000

To determine the actual strength of the concrete used in the beams sets of four-inch cubes were made and tested at 7 and 28 days. These tests show exact information which the beams do not.

One set of six 1:2:4 clinker cubes averaged 700 pounds per square at 7 days and 1,120 at 28 days. Another set gave an average of 915 pounds at 7 days and a third set gave 760 pounds at 7 days and 1,519 pounds at 28 days.

These results are by no means complete enough to give to the engineering profession absolute data for de-

Ceresit Waterproofs tunnels, foundations, tanks, pits, basements, reservoirs, swimming pools. bridges, walls, towers.

Cribben & Sexton' s Stove Foundry, Chicago. Boiler Pit Waterproofed with Ceresit

Ceresit Waterproofing was used on these jobs: Entire foundation and floors, Harper Memorial Library, University of Chicago. McCormick residence, Chicago. Harold McCormick, residence, Lake Forest, Ill. Swimming Pools—Ravenswood Y. M. C. A. Hyde Park Y. M. C. A. Swimming Pool, 150 ft. x 75, South Park Commission, Chicago. Reservoir of Concrete, Riverside, N. J. Tunnel Can. Pacific R. R. Depot, Montreal. Boiler House. Smith Bldg., Chicago. Sewer—Interborough Rapid Transit, Bdwy., N. Y.

Ceresitized Concrete is Waterproof

No matter what your past experience may have been with so called water proofings, please do not fail to try Ceresit on your next concrete job that requires an efficient waterproofing. We will give a bond that it will satisfy you in every way.

Ceresit Waterproofing is sold in the form of a cream white paste. This paste is readily dissolved in water and this water is used, instead of plain water, when mixing the concrete. This water mixes uniformly with the particles of cement effecting a chemical and physical change in the entire mass without affecting the tensile strength of the concrete.

"Ceresit" Waterproofing

Ceresit being incorporated in the concrete mass cannot of itself be chipped off or cracked. It is there to stay as long as the concrete stands and the waterproofing is as thick as the concrete wall.

Ceresitized Cement Mortar is Waterproof

Ceresit may also be dissolved in the water before the water is mixed in cement mortar for coating.

The Ceresit is uniformly distributed throughout the mortar and renders it waterproof and dampproof.

Ceresit is not to be compared to the so-called compounds or powders which cannot be uniformly mixed and which in consequence can only hope to waterproof the concrete or cement mortar in spots.

Nor is it to be compared with mere coatings or paints claimed to waterproof. These decompose, crack and chip off in time allowing the water to penetrate the mass, exposing it to the danger of disintegration by extreme changes of temperature.

Ceresit really and truly protects concrete and cement mortar from frost and efflorescence. It is a real waterproofing.

Our Guarantee and Bond

We guarantee the permanency and satisfaction to the the user on every job done with Ceresit under our direction and we will give a bond to back up our guarantee when desired.

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Ceresit is catalogued in "SWEET'S" Index. Ceresit is used in all civilized countries. See our exhibit at the Cement Shows. Booth 221, New York Cement Show. Booth 130, Chicago Cement Show

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sign, but they are complete enough to make the following assertions: First. The clinker concrete is better than the ordinary gravel concrete. Second. It is almost if not quite as good as the best gravel concrete. Third. It is far superior to cinder concrete. Fourth. If properly mixed it will give uniform results under test. Fifth. It can be used to advantage in mass concrete. Sixth. The tests have not been carried far enough to warrant its use in reinforced concrete. Seventh. The city of Milwaukee can use this material for any of its concrete work and provide an income for running the garbage disposal plant. Further tests are necessary to determine the mixture of cement, sand and clinker which gives the maximum strength for the same cost of materials.

RECORD CEMENT PRODUCTION.

The New Aetna Portland Cement Co. of Fenton, under the supervision of W. H. Simmons and his corps of assistants continues to smash records in production. During August the kilns burned 35,508 barrels and the grinding room turned out 43,008 barrels. The shipping department sent out 44,119 barrels. In July the shipments were 40,261 barrels, making a total for the two months of 84,380 barrels. These shipments were made possible by the use of sacking machines which were put in this season. These records for burning, grinding and shipments for August break the records for June and July and, in fact, all previous records of production for the mill. The guaranteed capacity of the kilns and grinding machinery were exceeded the past month and a remarkable season's run will be recorded if the mill keeps anywhere near this mark for two months longer.

NEWS ITEMS.

A new gypsum plant, with a capacity of 200 tons a day, has just been completed at Winnipeg by a newly-organized firm, called the Dominion Gypsum Company, Limited. The construction work on this plant has been rushed to such an extent during the summer that the company was able to make its first shipment last week, which consisted of twenty-five tons. The plant is driven by seven large motors, which are driven with 730 horsepower, supplied by the Winnipeg civic power plant.

A complete set of standard tube mills for the Edmonton Portland Cement Company's plant on their property west of Edson, Alta., has been purchased from the Chalmers & Williams Company, of Chicago, manufacturers of mining and cement manufacturing machinery. J. W. Young, vice president of the Chicago company, was in Edmonton last week closing the deal for the sale of the machinery. It will be shipped to Edmonton and then to the property for installation at an early date.

The Syracuse (N. Y.) *Herald* says that the transfer of the Empire Portland Cement Company and its property at Warner to the Franklin Manufacturing Company of Franklin, Pa., has been completed and the deed has been taken by the Keystone Company. General Charles Miller, of Franklin, an important factor in the Franklin concern, held the controlling interest in the Empire plant. The buildings and equipment at Warner have been sold to a western company, and as far as could be learned no plans have been made for the Franklin Company to move any plant here.

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NEWS ITEMS.

Mr. F. X. Cleary has resigned his position as advertising manager for the Western Electric Company, to engage in special advertising and sales promotion service in the electrical field, for which his long service as salesman, sales manager and advertising manager has eminently fitted him. Mr. P. L. Thomson, formerly manager of the Western Electric Company's Pittsburgh house, has been appointed to succeed Mr. Cleary.

The Pacific Concrete Tank Co. was recently incorporated at Los Angeles, Cal., with a capital stock of $25,000. The directors are C. S. Swain and J. A. Gibson, Jr.

The board of public works of Kansas City let a contract last week to the C. A. Brockett Cement Co. for 2,500 barrels of cement for the new pavement on Fifteenth street. The price was 88 cents a barrel.

The Aetna Portland Cement Co., Fenton, Mich., have just received their new tug from the makers. The boat is 45 feet long with a 12-foot beam. The management is making ready for annual repairs during which time the plant will be closed.

Reinforced concrete slabs for screens and partitions, at the North station of the Boston Elevated Railway, are made of a 1:2:4 mixture of Portland cement, granite crusher dust and small granite screenings. The slabs are reinforced with Clinton wire cloth and round rods in both directions. Dowels, projecting at the sides and ends, are cemented into the adjacent slabs by a mortar filling. The slabs are cast flat in a sand mold and when firmly set the upper surface, which is flat, is highly polished; this gives a finish, it is stated, similar to the best granite or marble. The exterior face is treated architecturally with panels and mouldings, and is left in the rough, as it comes from the form with a coating of sand.

The Furst Concrete Scow Construction Company, was recently incorporated at Baltimore, Md., with $100,000 capital stock, to build concrete scows and vessels.

The Keokuk & Hamilton Block Co. was recently organized at Hamilton, Ia., with a capital of $5,000, for the manufacture of concrete blocks. They have purchased an Inman block machine, a mixer and an engine.

CONCRETE PILES IN COLD WEATHER.

In cold weather it is the practice of the Raymond Concrete Pile Company to heat the sand, stone and water to be used in connection with the cement for making concrete piles. To heat the water a steam pipe is usually run from the boiler to the barrel containing the water alongside of the mixer. The sand and stone are heated in various ways: by piling them on steam coils connected with the boiler; by employing a separate boiler for heating coils of pipe and placing the sand and stone on these coils; or by using some of the sheet iron of which the shells are made, building a wood fire underneath it and piling the sand and stone on the sheet iron. After the shells are filled with concrete they are usually covered with gunny-sacks, straw or manure. In case manure is used care is taken to prevent it from coming in immediate contact with the concrete.

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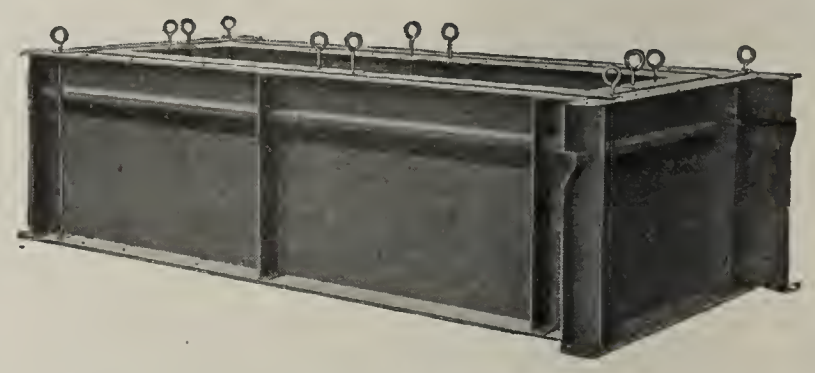

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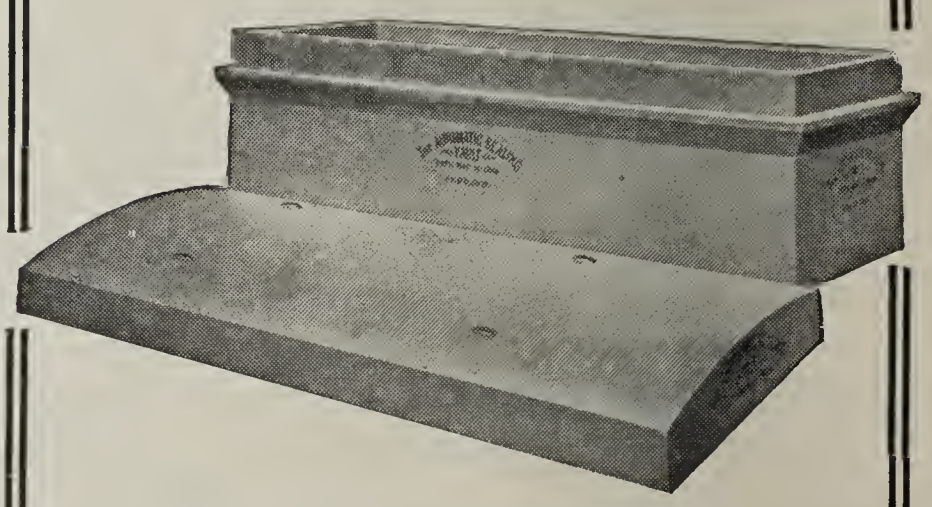

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GRAPHITE MADE FROM COAL.

Graphite, the commonest use of which is seen in the "lead" pencil, is almost pure carbon. This mineral is therefore only a step removed from coal and in fact some of the natural graphite deposits are found in coal beds where the intrusion of masses of intensely heated liquefied igneous rock has metamorphosed the coal, thus forming graphite. An example of this natural manufacture of graphite out of coal is described in one of the reports of the United States Geological Survey on the Raton coal field of New Mexico. On the other hand, large quantities of high-grade graphite are artificially manufactured direct from ordinary coal.

In making lead pencils the graphite is mixed with a clay of fine grain and the greater the proportion of the clay constituent the harder the pencil. Exceedingly soft pencils with large leads contain but little clay.

ASHLAND FIRE-BRICK CO.

The Ashland Fire-Brick Company, are installing an extensive conveying system for storing and reclaiming their clay. The system consists of a continuous bucket elevator, 51 feet centers, which delivers onto a 16-inch "S-A" Belt Conveyor, 180 feet centers, located on a trestle. This trestle and one parallel to it, 41 feet away support a moving truss which carries an 18-inch flight conveyor which receives from a tripper on the belt conveyor and distributes the clay to the pile below. A system of three "S-A" Belt Conveyors aggregating 400 feet in length, located in tunnels beneath the pile reclaim the clay and deliver to a 20-foot bucket elevator.

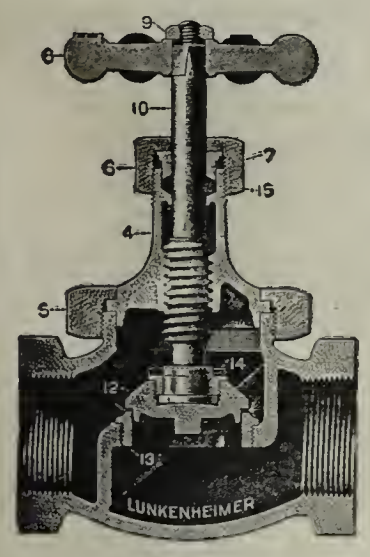
REINFORCED CONCRETE CONSTRUCTION.

Reinforced Concrete Construction is the title of a 300-page publication by H. Adams and E. R. Matthews just received from the press. The book contains enough, and fortunately not too much, mathematics to make it interesting and valuable to the reader and treats in an exhaustive and practical manner all branches of reinforced concrete construction. More than 300 cuts illustrating modern work done in concrete add life and charm to the ambitious compilation. No contractor or practical superintendent striving for mastery in this art should be without it. Price, $3.00; forwarded postpaid by Cement and Engineering News upon receipt of price.

REINFORCED CONCRETE PATENTS.

A pamphlet by Chas. J. Williamson, patent attorney, dealing with legal questions of vital importance to the owner, engineer, architect and builder. It discusses the scope of reinforced concrete patents, their monopoly value and the consequences of infringement. The booklet owes its origin to the frequent misinformation, and even misrepresentations, in concrete patent matters.

We have in our editorials, more than once referred to the incompetency of the patent office and to the ridiculous mistakes made in granting patents on concrete construction, as well as to the ignorance and dishonesty on the part of many patentees, and therefore heartily welcome the publication and trust it will soon be supplemented by numerous others on related subjects. Price, 50 cents; sent postpaid by Cement and Engineering News upon receipt of price.



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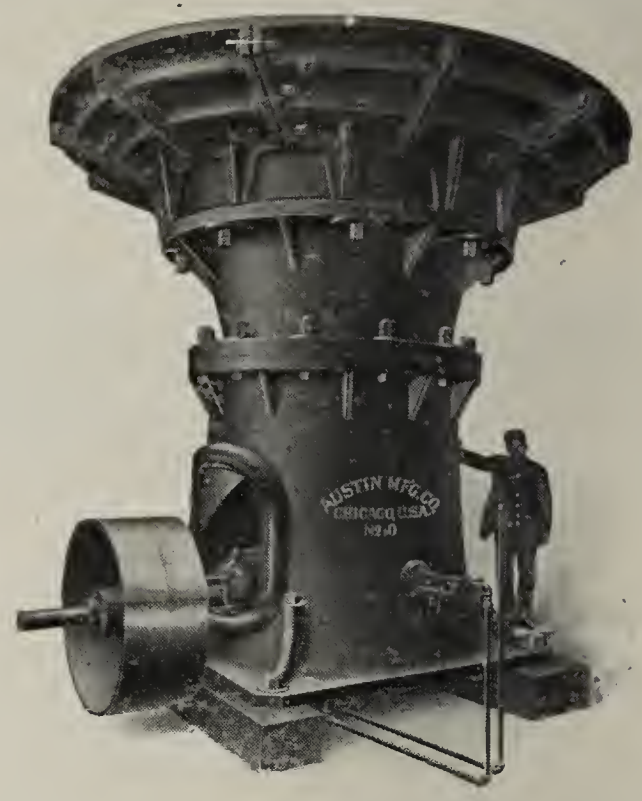

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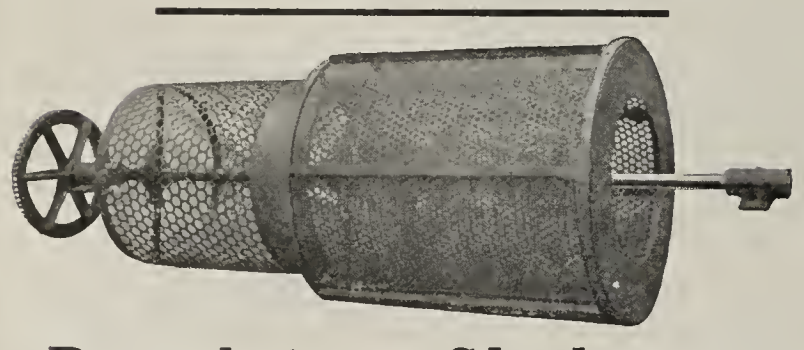

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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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CHICAGO, FEBRUARY, 1912

SAFETY IN CONCRETE CONSTRUCTION PREFERABLE TO SPEED.

The numerous accidents occurring every winter in the course of erection of reinforced concrete structures, owing to the premature removal of forms, bring forth at regular intervals a series of articles written by the two opponent parties in concrete construction, namely by the advocates of safe construction and by those who declare concrete to be the building material fit under all conditions under which other materials hitherto have failed to be efficient.

These topics have been discussed by the various parties interested in concrete construction so often that it would appear a satisfactory solution could soon be found covering the demands of both parties or finding a compromise between the rules advocated by the builders of these widely differing opinions.

However, years pass by without any apparent relief and accident seem to increase in number rather than to diminish. The building departments of our large cities and the officers at the head of associations of cement manufacturers and users appear to be too lenient in placing the blame for disastrous results.

As long as we find articles re-printed in technical magazines, as for instance "Concrete, The Cold Weather Building Material" or similar publications recommending concrete on the strength of rapid construction, we feel unsafe, and necessarily realize that more harm than good is done to the industry. Concrete is unsafe enough in the hands of most contractors, even in warm weather and if the construction proceeds slowly, under the present unsatisfactory building regulations. It will become safe only from the day when constant testing of the concrete for compression strength, done on the premises under the prevailing weather conditions, becomes a law, as frequently advocated by us, for instance in our April, 1910, editorial. Then contractors will find that the forms may be taken down in summer in the course of two weeks and in the fall and winter only after about two months, or even after longer periods. The strength of the concrete will then be the governing factor in concrete construction, and not the lack of patience of the architect and builder.

So far this sole reliable method of building has been found to be too expensive in the minds of most advocates of concrete, so that we have to continue to adhere to the unsafe regulations until further disasters will open the eyes of the building public and will make these most necessary precautions imperative. That day will be the beginning of the era of concrete construction; so far we are only experimenting with more or less disastrous results.

NOVO GASOLINE ENGINE.

The Novo Gasoline Engines manufactured by the Novo Engine Co., Lansing, Mich., have proven to be the simplest and most economical engines for running concrete mixers and hoisting machinery, according to numerous testimonials contained in the catalog of the Novo Engine Company, which we advise our subscribers to order and to read carefully.

TESTS OF WATERPROOFING COMPOUNDS.

The Harbor & Subway Commission of the City of Chicago is preparing to make comparative tests of all and every compound available for waterproofing such structures that need waterproofing. All parties desiring to enter their compounds in this series of tests must communicate by letter as soon as possible with the Harbor & Subway Commission, 105 S. La Salle St., Chicago.

TUFA CEMENT APPROVED.

Mayor Alexander of Los Angeles transmitted to Joseph Simmons, several reports of experts on the quality of tufa cement which is manufactured by the city and is being used in aqueduct construction. In a letter sent to the mayor some time ago Mr. Simmons questioned the character of the city's product and was inclined to condemn it.

The reports of the officials and experts forwarded to Mr. Simmons show, as the result of tests made, that the tufa cement is an excellent material and has the high qualities attributed to it. Among the reports submitted are those of Chief Engineer Mulholland of the aqueduct; of the Pittsburg laboratories, by P. H. Bates; Professor Lawson of the University of California and Mr. Crosby of international reputation. Mr. Crosby says that the tufa cement needs no defense.

CALIFORNIA PORTLAND CEMENT CO.

A curious decision has been rendered against the California Portland Cement Co., by the supreme court of California. It sustains an injunction against that company which compels them to shut down all but a very small part of their plant on account of the alleged injury done to the growing fruit in the vicinity of the mill. A number of orange growers filed suit against the cement company and alleged that the dust from the mill ruined the growing fruit and they asked that the mill be shut down or that it adopt some method of preventing the dust. The company has spent about $75,000 for a process to control the dust as the decision of the court makes it imperative for them to either control the dust or shut down the plant.

A Water Tank Built of Concrete

This reinforced concrete tank, which was designed and built at Sir John's Run, West Va., by the Steel Concrete Construction Company of Harrisville, Pa., for the Baltimore and Ohio Railroad Company, during the summer of 1911, is complete in all details, is giving perfect service and is watertight. Lehigh cement was used.

This tank is supplied by a ten-inch gravity line from

Fig. 1. Excavating for Foundation.

a reservoir back in the mountains, the line extending to the top of tank and being equipped with float valve, thus letting in the water as needed, but avoiding any waste. This line also feeds direct into the sixteen-inch discharge line from the tank by means of a by-

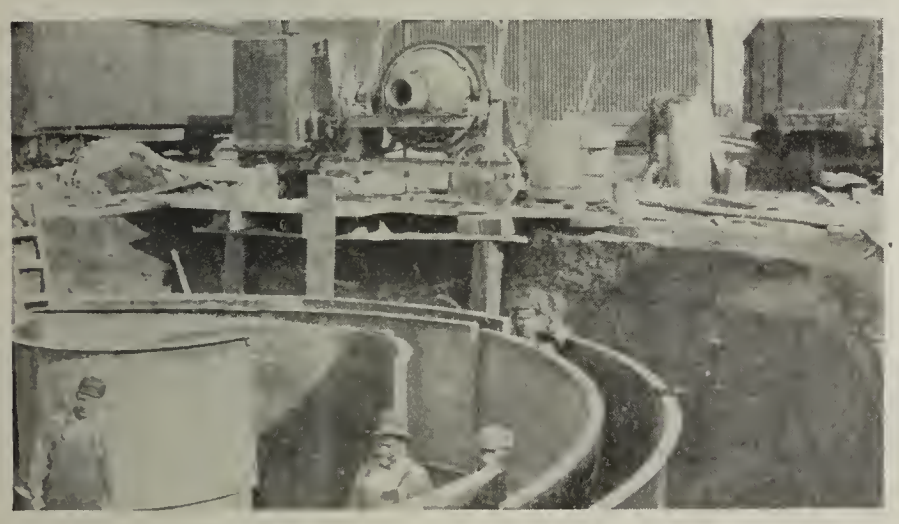


Fig. 2. Placing the Forms.

pass connection which is not concreted in and is operated by means of valves to feed either into the tank or direct to penstocks as may be desired. Thus the water supply is on when the sediment is being cleaned out of the tank. The tank is also equipped with a 6-inch overflow extending to the top of the tank and this line has a branch clean-out at the tank bottom so that any sediment may easily and quickly be disposed of. In addition there is an 8-inch suction and discharge line from the river to top of the tank. This is equipped with a suitable pump which is used only in case the gravity supply should run short. The vertical pipes are all concreted in place in a center supporting column, 7 feet in diameter.

The concrete in base is a 1:3:5 mixture, the elevating structure a 1:2:4 mixture and the actual tank a richer and differently proportioned mixture, but all the concrete has a proper amount of hydrated lime in it, used as a waterproofing compound. The walls are not plastered or treated, but are left as they came

Fig. 3. Forms in Place.

from the forms except that they were given two coats of paint to make the structure a uniform color.

Fig. 1 shows excavation and concreting of foundation, excavation is 22 feet below rail base of the coal track. Reinforced concrete base 4 feet thick by 33 feet diameter. Fig. 2 shows forms being placed. Fig. 3 shows forms and complete outfit in operation on the 24-inch wall of the basement of structure, which is

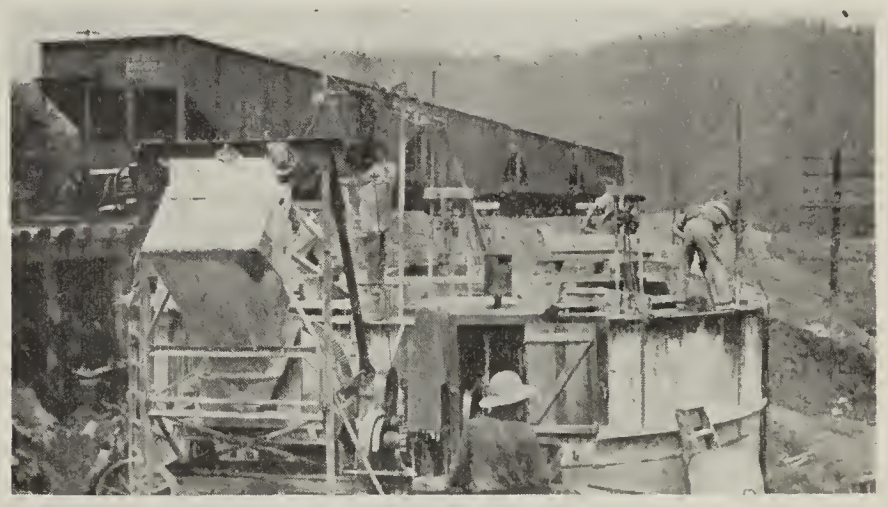


Fig. 4. Forms at Coal Track Level.

the pump room, 18 feet high to floor at level of the coal tracks from which the bunkers are supplied. This floor is 6 inches thick of reinforced concrete. Fig. 4 shows operations one fill of forms below the floor at coal track level. Fig. 5 erection of tank elevating structure, the same being 12 inches thick beginning at floor, coal track level and tapering to a 10-inch wall at the actual tank bottom. Fig. 7 shows the reinforcing steel of the actual tank bottom. Look closely and you will notice just below the vertical wall form, the horizontal bars which meet the lateral pressure, and also notice the bars running parallel to the I-beams. These bars begin in floor center and extend outward to the vertical walls, then upwards in the same 4 feet to 5 feet and are fastened to the horizontal bars in the sides, there are 64 of these bars and 32 of the I-beams placed in the floor, beams are 10-inch 25 lbs. per foot. Fig. 8 shows operations one fill of the forms below completion of structure, the vertical hoisting

pipes, chain blocks, etc., are in place ready for the final lift. Figs. 9 and 10 show the tank completed.

The actual tank is 24 feet inside diameter by 30½ feet deep. Capacity 100,000 gallons. Walls are 10 inches thick at tank bottom and taper to 7 inches at the top, extreme elevation of water 60 feet above base of rail, serving four tracks from the two pens.

The main features of the concrete tank which make them a success, and the appliances used to construct them are quite fully protected by the McCoy patents.

Fig. 5. Erecting of Tank Elevating Structure.

MISSOURI HIGHWAY ENGINEERS.

The officers of the Missouri Highway Engineers' Association have just decided to hold the next annual convention of the association in Kansas City during the first annual Kansas City cement show, March 14-21. The meeting of this organization during the cement exhibition, will be welcomed by the exhibitors and the cement show interests generally.

The improvement of public highways is a field

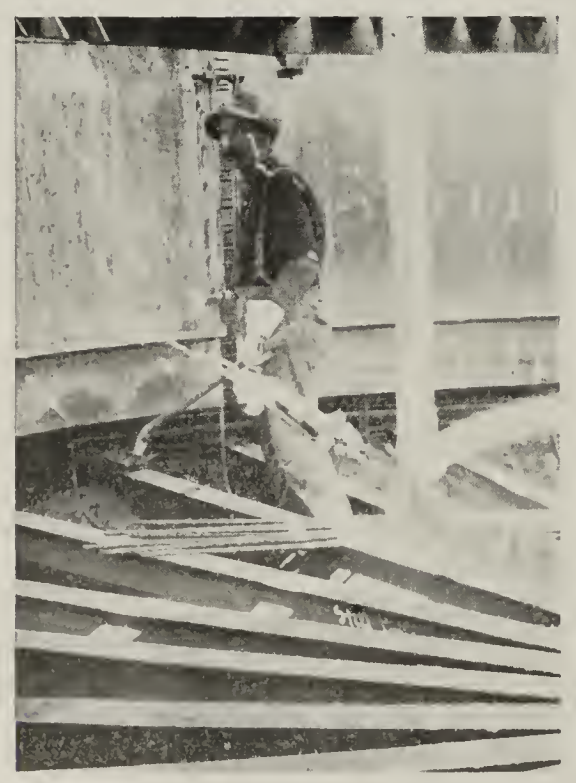


Fig. 7. Reinforcing of Tank Bottom.

which is becoming constantly more important to the makers of Portland cement and the manufacturers of cement-using machinery. There has been a great development recently in the application of concrete to the construction of pavements. The all-concrete pavements have not only been demonstrated possible, but entirely successful.

Fig. 8. Tank One Fill From Completion.

Secretary Clark of the Highway Engineers' Association, is making a special effort to bring out a very large attendance of engineers and county commissioners of the State of Missouri.

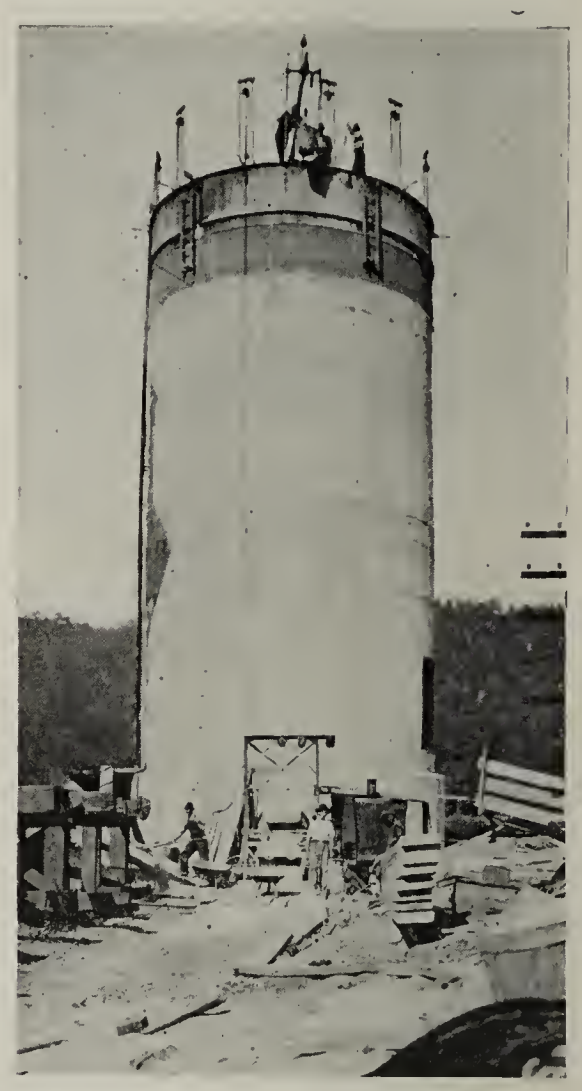


Fig. 9. Tank Nearing Completion.

Fig. 10. Tank Completed.

The Adulteration of Portland Cement*

By R. C. Carpenter.

Because of the low price of Portland cement prevailing at the present time, it is one of the materials in which adulterations would seem improbable, and so far as the manufacturers in this country are concerned, I believe this assumption is not only reasonable but it is also true.

It has been claimed that by the use of certain adulterants in Portland cement the quality could be improved rather than otherwise, and so far as investigations have been made in the past, there is a good deal to support such a statement. It is very important from the manufacturers' standpoint to ascertain just what effect the mixing or grinding of certain inert substances has on the cement. This information is also important for the engineer who is to use the cement. In general, the grinding in of inert substances will lessen the cost of manufacture very nearly in proportion to the use of the inert substance. The result, therefore, would be to give the manufacturer making or selling the adulterated cement a large advantage over his competitors and correspondingly to handicap the man who was manufacturing pure cement which was sold in competition with adulterated cement.

It may be well to call attention to the character of the manufacturing process for Portland cement. Briefly stated, this consists in grinding together definite quantities of lime and clay which are later burned at an extremely high temperature and finally ground to a fine powder. Some gypsum, usually about 2%, is ordinarily ground with the cement in the final grinding to regulate its setting.

The simple statement of the process as above gives very little notion of the machinery required for power, quarrying, grinding and conveying the various materials. It must be sufficient at present to state in this connection that the cement industry is a very important branch of applied mechanical engineering and that the construction, design and operation of these plants call for a high-grade engineer.

In the manufacture of Portland cement the product is affected by (1) the character of the raw materials; (2) the proportion of the various chemical ingredients; (3) the fineness of grinding both of the unburned and of the burned material; (4) the thoroughness of the burning operation. Unsound or weak cement will result from the failure to maintain any of the manufacturing operations up to its proper standard.

Portland cement is almost always used in connection with sand, water and broken stone, to form a mortar or concrete. It is the most extensively used today of any building material, and because of its stone-like properties and its wonderful endurance, its use is constantly increasing. The manufacture of cement is for this reason one of the large industries of the country and one which gives employment to a great number of mechanical engineers.

Adulterations in Portland cement have generally been looked upon as detrimental to its quality and the specifications adopted for its use have been of a character to exclude it. If, however, it should turn out that certain inert quantities used in quite large proportions resulted in improving the cement from every standpoint, as is claimed by certain investigators at the present time, it would seem proper to change the specifications so as to give the consumer the advantage of the better material and lower prices. The present specifications which have been adopted by the American Society of Civil Engineers define Portland cement as "a finely pulverized product resulting from the calcination to an incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous material, and to which no addition greater than 3% has been made subsequent to calcination." The definition as given above would preclude the use of an adulterated material under the name of Portland cement.

Respecting the adulteration of cement, the following inert materials have been ground with it at different times, and a considerable amount of building work has been executed with such adulterated cement.

a. Clay, either raw or burned.
b. Slaked lime.
c. Sand.
d. Ashes.
e. Natural cement.
f. Products of natural rock like ragstone or tufa.

Natural cement, which is made by burning natural deposits of magnesia and limestone rock, was at one time extensively manufactured in eastern New York and generally sold under the name of Rosendale. This material could be made very cheaply and it was generally put on the market rather coarsely ground. It has the property of setting very quickly, but at the end of a month would hardly attain the strength that Portland attained in one week. This cement was used extensively and a long lapse of time has proved it to be sound and reliable. At the present time the amount of Rosendale made is very small and it is not available as an adulterant.

I have known personally of grinding into Portland cement amounts ranging from 100 to 150% of natural cement and I have made various investigations of the resulting product. I also have had occasion to examine recently some constructions built with such material about twelve years ago. My investigations indicated that Portland cement could be ground with practically an equal amount of Rosendale cement with no loss in its sand-carrying quality or its strength. In some cases the effect of grinding the Rosendale into the Portland was to improve the strength and hydraulic properties of the mixture.

Very fine sand ground up into the cement has been used extensively as an adulterant. I know personally of the extensive use of material of this kind a number of years ago and from which no bad results have been experienced; on the contrary, the results apparently are equal to those obtained with pure Portlands. Some fifteen years ago Capt. W. M. McClay, formerly of the Dock Department, New York City, and later president of the Glens Falls Portland Cement Co., took out a patent for the grinding together of Portland cement and sand, forming a siliceous mixture which was sold as "silica cement." The good results obtained with this material were thought by many engineers to come largely from the extra grinding which the Portland cement received when the sand was added. The cementing properties of a Portland cement are known to increase with the degree of fineness and this explanation seems to account at least in part for the results. This material was used in a

*Reprint from "The Sibley Journal of Engineering," Dec. 1, 1911.

good many structures, notably in a dam across the Mississippi river near St. Paul, built by United States engineers. The expense of it as compared with pure Portland cement is responsible for its disappearance from the market. Some engineers have reported respecting "silica cement" that its strength fell off when mixed with large quantities of sand as compared with pure Portland cement used under the same conditions; in other words, that while it might be better than pure cement when used neat, it was inferior when used with standard quantities of sand. It is quite evident that any inert material to be of value must not lessen the good qualities of the cement when used with normal amounts of sand.

The use of various percentages of clayey material for grinding into Portland cement, after calcination, has perhaps not been extensive, but investigations tend to show that such material has no detrimental effect on the cement and can be added in quite large quantities without reducing the strength of mortars even when used with large quantities of sand.

I merely call attention here to one investigation made on a mixture of three of sand to one of cement, in which different quantities of clay were used, and which shows a large increase in strength as the per cent. of clay is increased to 15%, and which is retained throughout the period of testing.

Tensile strength	Lb. per square inch		
Age	1 month	3 months	1 year
No clay.....	200	335	390
2% clay.....	330	370	430
6% clay.....	300	470	490
10% clay.....	370	450	590
15% clay.....	400	500	620

Quite recently it has been proposed, especially on the Pacific Coast, to grind a volcanic tufa having composition very much like clay, with cement. In the construction of the Los Angeles aqueduct the Portland cement used in the later period was adulterated as much as 200%, by the grinding in of this material. I have myself taken part in investigations comparing the results from this adulterated material with the results obtained with pure cement. Up to the present time such investigations have not indicated that the practice of grinding in the tufa was dangerous or that the resulting structures were weak and would not be permanent. Sufficient time has not elapsed to make it safe to draw any conclusions other than those stated above from my investigations. When later investigations to which reference has been made are completed I believe our conclusions in this respect will be of value.

Slaked lime has been frequently ground into Portland cement after calcination and I have also investigated that practice. This material has a decided effect in regulating the setting and also tends to make the cement waterproof. Added in quantities up to 50%, it does not reduce the strength for normal quantities of sand, and so far as my investigations show it does not lessen the value of the completed work. Slaked lime must be used with care since any particles which are not thoroughly hydrated will tend to make the cement unsound. It is rather expensive and is not likely to be extensively used because of that fact.

The action of these inert materials, in many cases, in improving the quality of Portland cement rather than injuring it, is in harmony with the theory of Michaelis, which is now generally adopted by all scientific investigators. Michaelis' theory in brief attributes the setting of cements to the desiccation of the colloidal hydrated aluminum silicates, formed when the cement is mixed with water and the later hardening as due to the formation of colloidal calcium silicate and calcium hydroxide, the latter in the crystalline form. This theory is essentially different from the Le Chatlier theory previously held by scientific observers and which attributed the setting as principally due to the formation of various calcium silicates.

As the colloidal properties are greatly increased by fine grinding, it becomes evident at once that the value of a cement depends largely upon the fineness of its particles. Many of the inert materials mentioned, especially the clays, have distinctive colloidal properties, hence it is easy to see that the addition of material of such a character within certain limits might exert a beneficial rather than a detrimental effect.

The present investigations so far as completed would indicate that Portland cement is not injured in its practical use by the grinding in of a number of cheap materials after calcination which are decidedly of the nature of adulterants. On the contrary, in many cases, investigations show a decided improvement in every desired quality. Provided the completed investigations show that the quality is improved by certain kinds of adulteration, the question will at once arise why should not the specifications for Portland cement be changed so as to admit such a practice, thus materially reducing the cost. The principal reason for not admitting adulterations is the same one that holds respecting pure foods for the cases where the adulteration is harmless, and that is the difficulty of controlling the amount and character of the adulterant. It is almost impossible to obtain an adulterated material which is of uniform character and which is made as represented. Specifications permitting adulteration would be difficult to enforce and consequently the results obtained with adulterated material would be uncertain.

THE HOBBS BLOCK MACHINE.

The Hobbs Concrete Machinery Co., 80 Boydell Bldg., Detroit, Mich., is placing a new block machine on the market with which, it is claimed, 1600 different sizes of block can be made. The Hobbs machine is easily and quickly adjusted, the back plate sliding on the frame to any desired position. Every adjustment is positive and absolute, and no part can slip without shearing a bolt or pin. One dividing plate for every size block is used, and no time is required to remove or insert the dividing plates, as they are operated by foot levers in combination with the cores, or used alone when making veneer block. Oval cores are used, so that a wet block can be made.

Rock-face block, on the Hobbs machine, are made from a special composition, said to be as hard as flint and nearly as durable as iron. These plates are cast direct from the natural stone and the rock face concrete so made is claimed to be an exact reproduction of the original stone. The company guarantees that the concrete, in making the block, will not stick to the face plates.

CONCRETE PIPE TRIUMPHS.

After a long and bitter fight by the clay interest the Kansas City Council has agreed to accept concrete pipe in competition with the clay product, and the first concrete pipe were laid in Kansas City, December 23, 1912. It is reported that the competition has already resulted in a reduction of from twenty to forty per cent in the price of clay pipe.

Hollow Wall Concrete Houses of Low Cost

Ever since its first settlement just one hundred years ago, the city of Rochester, N. Y., has attracted the attention of the country because of its varied industrial activities, which are traceable to its immense resources of natural waterpower and the rich tributary country surrounding it. Another feature of exceptional interest is now added to its record, in the shape of a most important contribution to the cement industry — namely, the actual construction, on a large scale, of concrete residences, without the use of any elaborate system of either wooden or steel forms, and at a cost so low as to be within reach of any family of moderate means. This achievement is due to the invention of the "Van Guilder" hollow-wall machine.

The actual construction of concrete houses, with walls having a complete and continuous air space from cellar to roof, finished in pleasing designs with various forms of stucco, at a cost that is in reality less than the cheapest frame construction for houses of similar size—is surely of interest to cement contractors, builders, and real estate operators everywhere. The advantages of a hollow-wall concrete house over a frame house are entirely obvious to cement users; it is almost unnecessary to say that such houses are warmer in winter and cooler in summer, sell for more than frame, and carry larger bank loans and less insurance. The erection of such houses at a cost lower than that of frame construction, is no longer a dream to be realized, but an accomplished fact.

A ROW OF HOLLOW CONCRETE WALL HOUSES BUILT BY THE VAN GUILDER HOLLOW WALL PROCESS.

For the past four years, W. N. Britton, a well-known real estate operator, contractor, and builder, of Rochester, N. Y., has been erecting hollow-wall concrete houses. The houses described and illustrated in this article are now being put up in the so-called "Britton" subdivision, in Rochester, a tract of about 132 acres lying along three streets, each a mile long, running west from Lake avenue, just south of the plant of the Eastman Kodak Company. Seventy houses of this type are being built by Mr. Britton this summer.

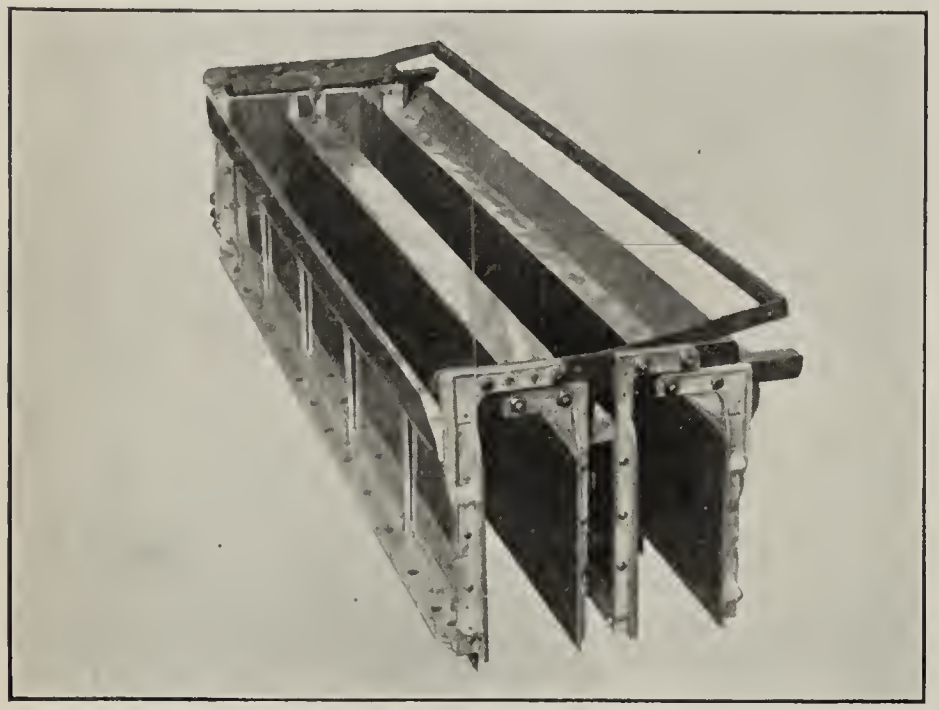
Naturally, the erection of these concrete houses involves the use of a patented device—known as the "Van Guilder" hollow-wall machine. Mr. Britton first experimented with this device four years ago, when, by rather laborious methods, he erected several hollow-wall concrete houses. From the start, these houses were a success, as they were easily sold or rented. The second year, about 10 houses were erected; last summer, Mr. Britton built 18 more concrete houses; this season, he is putting up 70 and even at that cannot supply the demand. When the houses were first built, Mr. Britton actually figured at renting them for less than frame houses; they are now renting for $26 per year more than frame houses of the same layout and dimensions, and when sold, bring from $400 to $1,000 more than the latter. It should also be stated that the demand for houses in this locality is steadily increasing, as they are built to sell and to rent to operatives in the Eastman Kodak Company's plant.

The houses under construction this summer are all the same size, 25 by 27 feet, outside dimensions, containing full basement, three rooms and hall downstairs, four bedrooms and bath upstairs, and a large attic. The concrete houses sell for about $3,200, and rent for $5.50 per week (all houses in Rochester rented by the week); frame houses of equivalent accommodations sell for about $2,800, and rent for $5.00 per week.

The work on the walls for the concrete houses is started with the Van Guilder machine, on the cellar floor. The inside and outside walls are each 4 inches thick, and the air space is 2½ inches, the machine building both walls and allowing for the air space at one operation. The courses as laid are 9 inches high, the machine at one operation building a wall five feet long—the length of the machine. The machine operator is an experienced concrete worker; three laborers are required to mix the concrete and carry it to the machine. The concrete is mixed 1:2:4, and as much water as possible is used, without making the mixture sloppy wet. The concrete is not poured, but is tamped down, which Mr. Britton claims to have found from experience to be the most satisfactory method. The mix used, by the way, is the same as that used by the government on the new cantilever bridge at Niagara Falls, N. Y.

The two walls are bonded together with wire ties

or creosote-dipped pieces of wood lath, these ties being later used as a resting place for the machine as the successive courses are added. The walls are also reinforced lengthwise by 5-foot pieces of twisted cable wire, or rods; and all concrete above windows and doors is reinforced with two or three pieces of this wire. As the wall is carried up, wooden pieces are inserted in the inside wall at the floor levels, these pieces later being taken out and the openings thus



The Van Guilder Concrete Hollow Wall Machine.

left affording safe and suitable resting places for the floor-joists. The floor-joists are put in as soon as the concrete is hard; this later affords a footing for the machine operator and does away with all scaffolding. No forms are used outside of the machine, and naturally, in operating the machine every precaution is taken to build absolutely level. Headers are used over basement windows only, for the floor-joists, as the concrete is not considered strong enough of itself

Hollow Wall Machine Constructing Cellar Foundation. No Forms or Lumber Used.

to carry the load at these points. The courses are bonded to each other by pouring water, in which considerable pure cement has been mixed, over the hardened wall; this method has proved entirely suitable. On an average, 9 courses are required around the foundation, and 23 courses around the superstructure.

Generally 14 days are required to complete the walls for these houses, by building 250 running feet per day. Under favorable weather conditions, the work on a single house has been done in 12 days. The work as actually done covers 300 running feet on foundation work per day, 260 feet on the first story, and 220 feet on the second story. The concrete work is in charge of George Goehringer, an experienced cement user. An "Eclipse" mixer, with an "Ideal" engine, is used.

The machine leaves the outside walls rough, so that stucco can be easily applied. Before putting on the stucco, the walls are dampened by simply turning a hose on them. The stucco is mixed 3 to 1, sifted sand and cement, and is applied from the top down, being loosely troweled so as to retain as much water as possible. Two masons and a helper can do the stucco work on one house in two days. The illustrations show the various ways in which the stucco is applied and how it is finished; an ingenious man can find an unlimited number of ways for finishing his stucco in pleasing designs. "Bay State" cement is used to color and finish the stucco, where a smooth effect is desired; in other cases, a granite finish is put on.

The walls, because of the hollow air spaces, are 10½ inches thick, over all. A concrete wall of this thickness requires a special finish for window and door frames. These are set flush on the inside, and 2 inches from the wall on the outside. The concrete from the casing to the outside wall is troweled smooth, and presents a suitable and pleasing finish.

No waterproofing of any kind is used in the construction of these houses. The wall is built with a continuous air-space, and the houses are thoroughly damp proof; this fact is attested by all of the occu-

Van Guilder Hollow Wall Concrete Houses.

pants of similar houses built last year and the year before. "Perfect" hot-air furnaces, made by the Richardson & Boynton Company, two sizes smaller than the furnaces used for similar-sized frame houses, are installed; and the man who foots the coal bills takes delight in telling that with his concrete hollow-wall house he requires $20 to $25 less for coal during the winter season than his frame house neighbor.

Mr. Britton's enterprise has been going on practically unnoticed by outside contractors for nearly four years. The houses he has erected of concrete have stood the test; the walls are stronger than ever; the occupants are enthusiastic; and the demand for the houses cannot now be filled. Mr. Britton is undoubtedly a pioneer in construction work of this kind, and he has carried it past the experimental stage. Furthermore, that the building of these concrete hollow-wall houses is a money-maker is surely attested by Mr. Britton's statement that he would not take $20,000 for his profits on the work this summer.

The cost figures given in the accompanying tabu-

lated lists of itemized costs are the actual amounts expended by Mr. Britton for these hollow-wall concrete houses, as well as for the frame houses. In outside dimensions, the concrete houses, as already stated, are 25 by 27 feet; and the frame houses, 24 by 26 feet. The inside dimensions are alike for both types of house, the difference being due to the necessarily thicker walls in the concrete construction. Both houses are the same height, the foundations being 7 feet, and the superstructure 18 feet high. Both frame and concrete houses have frame roofs, shingled. The cost of excavating the cellar and footing is not included in the figures below, as it is the same for both houses, and depends entirely upon local conditions.

Relative Cost of Hollow-Wall and Frame Construction.

Concrete Work—		Concrete Frame
Man to operate machine, 14 days, at $3.50 per day	$ 49.00	
3 laborers, 14 days each, at $1.75 per day	73.50	
Concrete mixer, including gasoline, 14 days, at $1.00 per day	14.00	
Cement, 41 bbls., at $1.20 per bbl., carload lots	49.20	
Gravel, 56 loads, at $1.00 per load (on property)	56.00	
Ordinary stucco finish outside	40.00	
Wire reinforcement and ties	5.00	
Total cost of concrete	$ 286.70	
Lumber bill	$ 300.00	$ 456.00
Lath, 6,000 for concrete; 8,000 for frame	30.00	40.00
Carpenter labor	230.00	315.00
Plaster, 5 tons, at $6.00 per ton	30.00	30.00
Brick, 1,500, at $8.00 per thousand	12.00	12.00
Flue lining, 22, at 30 cents each	6.60	6.60
Mason and helper	60.00	60.00
Lather	15.00	20.00
Inside trim, chestnut	350.00	350.00
Plumbing	250.00	250.00
Furnace (concrete house two sizes smaller)	100.00	120.00
Hardware	30.00	30.00
Paint and painter, inside and out	90.00	160.00
Tinning, nails and incidentals (saving for concrete house principally in nails)	135.00	150.00
Window frames, 22, at $2.10 each	46.20	46.20
Building paper, 6 rolls for frame house, at 80c per roll		4.80
Solid concrete foundation walls for frame house		140.00
Total cost for both houses	$1,971.50	$2,190.00

As can be seen from the above figures, the hollow concrete houses in this article are built for $219.10 less than the frame houses. The figures for cement and gravel will vary in different localities; and where gravel and sand must be hauled a great distance, naturally the cost is increased. The difference in the quantity of lath is due to the fact that in the concrete house no lath is used on the outside walls, the lathing required being for inside partition walls only.

It may be interesting to add that Mr. Britton has also built by the Van Guilder hollow-wall system a storage warehouse on his property. This warehouse has two 4-inch walls, with 2½-inch air space, and carries from 100 to 200 tons of cement. This well illustrates the enormous strength of the walls.

The machines used in the construction work described in this article are manufactured and sold by the Van Guilder Hollow Wall Co., 718 Chamber of Commerce Building, Rochester, N. Y.

HENDRICK'S COMMERCIAL REGISTER.

Hendrick's Commercial Register (Twentieth Annual) of the United States for Buyers and Sellers, is just off the press. It requires 108 pages to index its contents. As necessary in the office as the typewriter or telephone. Established 1891. Over 1,600 pages. Price $10, express charges prepaid, issued annually. More than 17,000 copies are now being used throughout the country for purchasing purposes by leading corporations, railroads, manufacturers, jobbers, dealers, exporters, architects, engineers, contractors, governments, institutions, mines, etc. Over 350,000 names and addresses of American manufacturers classified under upward of 35,000 classifications, representing about every machine, material, tool, apparatus and specialty required in the architectural, engineering, mechanical, electrical, manufacturing, railroad, mine, mill, quarrying and all kindred industries, embracing everything. For railroads, from a track boat to a locomotive. For building and construction, every known material, specialty, apparatus, machine or tool required. For mines, from a miner's lamp, ventilating fan or concentrator to a stamp mill or steel tipple. For municipal work, from a paving brick, sewer pipe or sewer inlet to a steam road roller. Hardware, everything in builders' shelf and heavy hardware, including a list of the jobbers. For water supply, from a water pressure gauge or gate valve to a pumping engine or standpipe. For foundries, from a molder's flask or molding machine to a cupola, including all brands of pigs, alloys, etc.

For power transmission, everything from a belt fastener to a complete system, including the latest specialties in right angle transmission and variable speed countershafts. For concrete work, everything from a socket, steel centering or reinforcing metal to a concrete mixer, including all brands of cement, etc. For agriculture, from a garden rake or lawn mower to a mower and reaper. For mill or factory, everything needed in the construction and equipment of same, and every operating supply required. Iron, steel and other metals, everything made from iron, steel, brass, bronze, copper, aluminum, platinum, zinc, lead, etc., whether cast, rolled, drawn, pressed or forged, including bar, plate, sheet, wire, structural and other shapes, pipe, tubes, bands, hoops, high speed, high carbon, tool and other high grade steels, bolts, nails, nuts, rivets, screws, rods, spikes, chains, shafting, reinforcing bars, etc. Castings of every description from all metals, including every machine, tool, furnace or material, etc., for the production of these metals. Machinery, over 2,900 classifications of as many different kinds, including the name and address of the manufacturers of about every machine required in the production or preparation of the raw material and the manufacture of clay, rock, ore, metal, wood, fibre, textile, cereal, chemical and other products in their various shapes and forms for the multitudinous uses of man. For the architect and engineer, every instrument and supply required for their use and every known material, machine, tool and specialty which they are called on to specify. The book also contains many valuable mailing lists of the entire country. For our commercial rating we refer you to Dun or Bradstreet. S. E. Hendricks Company, 74 Lafayette street, publishers, New York City.

Dust in Portland Cement Plants

By Otto Schott

There are few branches of industry that can vie with that of Portland cement manufacture in the production of dust. Cement factories working with the wet or half-wet process are an exception to this, since dust from drying and grinding the raw materials and in burning the clinkers is not encountered. There are many sources of dust with the wet process in common with the dry, such as the drying and grinding of the coal, the grinding of the clinkers and the packing of the cement. In any case, the dust-eliminating question presents itself as an urgent problem. The dust collector has become a necessity for any cement plant. But little experience having been so far gathered in America in this particular respect, the explanations in this paper will be based on the experiments and experiences of German cement factories, in which such devices have been in operation for a long time.

The dust-eliminating devices used in European cement factories have, generally speaking, hygienic motives, inasmuch as the authorities demand the use of such contrivances that will protect the physical welfare of the workmen and keep the environs of the factory free from dust. The great progress made in this line, however, would hardly have been possible for this reason alone, had not the dust-collecting devices been found to represent the means of great economy and money-making.

Two points to be considered are: (a) Dust-eliminating contrivances for depositing or beating down the dust originated in grinding, packing and conveying the materials when the temperature of the dust-filled all is normal; (b) removal of the dust from the waste gases of the drying drums and kilns, a more difficult problem owing to the high temperature and to the aqueous vapors contained in the gases.

Dust-Eliminating Devices.

With the dust-eliminating devices first referred to it is essential that the mills and conveying contrivances causing the dust be covered or jacketed as tightly as possible. It is furthermore of great importance to withdraw the dust immediately at the place of origin, hence to connect the mills and other contrivances directly with the exhauster destined to remove the dust-saturated air by suction instead of allowing the dust first to penetrate to the outside and then attemping to cleanse the space saturated with the dust.

Every dust-eliminating plant consists in general of these principal parts, viz., the exhauster, the dust separator and the pipe conduits. Absolutely indispensable for every such plant is the exhauster which serves to remove by suction the dust-saturated air from the dust sources and to conduct the same to the dust separator; therefore the construction of this machine requires particular discrimination and care. Its volumetrical and mechanical efficiency and capacity must be as high as feasible, i. e., must be so constructed as to remove suctorially a quantity of air with the least possible consumption of power. The proper shape of the air wings and of the casings are in this device of the greatest consequence. The casings have to be so constructed as to permit the air to leave without any resistance, i. e., without any concussions or shocks.

The width of the suction aperture of the exhauster is dependent on the requisite working result relative to the air, multiplied by the degree of depression. Greater air actuating work and smaller depression necessitate a wide suction aperture and vice versa. Considering the great number of revolutions in the exhausters, reversible ring lubricated bearings are the most advantageous.

For cleansing the dust-saturated air drawn through the exhauster by suction there are three technical methods in use: (a) diminution of the velocity of the air; (b) filtration of the air through jute filters and (c) elimination by centrifugal force.

Diminution of Air Velocity.

With the first method mentioned of removing the dust, the dust-saturated air is led into large chambers and thereby undergoes a diminution of speed proportionate to the cross-section of the chamber. Consequently a large portion of the dust is deposited on the bottom of the chamber. In order to produce satisfactory results, such chambers must have relatively considerable dimensions. It is not difficult to free small mills from dust by this contrivance, but for larger plants the requisite dimensions must increase according to the third power of the size of the plant. In Europe, where the cement industry dates rather far back and where the rotary kilns were taken from America, the spaces enclosed by the now disused ring kilns are suitably utilized as dust chambers, being sufficiently spacious for that purpose. Moreover, the construction of such dust chambers is not expensive, provided the requisite space is available. They may be built from cement or gypsum boards 2 in. thick, as in many factories in Germany. The dust falling to the bottom of the chamber is removed automatically by a screw, spiral or chain conveyor. The separation of dust may also be increased by constructing baffle works in the chamber which causes contact or friction with the air. Sometimes we find objects of resistance in the shape of wire netting stands or hemp skeins suspended in the chambers, such devices causing the dust first to adhere to them and then drop to the bottom of the chamber. The greater portion of the dust may be deposited by the aid of such dust chambers, but a certain amount of dust will always be taken along with the air escaping from the chambers.

Dust Filters—In a consideration of the dust filter, the device most used for the separation or elimination of dust, two principles are involved: (a) the exhauster is inserted between the source of dust and the filters so as to cause the dust-saturated air to be pressed into the filter; or (b) the exhauster is arranged behind the filter and draws the dust-saturated air from the mill through the filter. The latter construction has found great favor in Germany as made by the firm of Betts, at Luebeck.

This dust collector consists of a number of separate sections of hose through which the dust-charged air is drawn by suctions. The dust adheres to the interior surface of the hose while the cleansed air is allowed to escape to the outside. In order to remove the dust from the apparatus the different hose are knocked out alternately and in shifts at regular intervals of time, by means of an ingenious mechanism. The suctorial action of the exhausters is suspended temporarily for these hose or sleeves by the automatic reversion of a flap or valve provided in the suction trunk. At the same instant the sleeves are freed from the dust by repeated raising and sudden dropping. Besides this the atmospheric air flowing in under high pressure and entering the interior from the outside through the casings of the sleeve cleanses the latter

completely. While part of the sleeves are thus being cleansed the exhauster draws the dust-saturated air by suction through the rest of the sleeve sets. Thus no interruption takes place and the dropping dust is carried away by a screw conveyor. To give an idea of the extensive application of these dust-eliminating plants, it may be stated that 20,000 sleeves with 1,600,000 sq. ft. of surface were in operation.

Of numerous factories that construct similar devices reference will be made only to the firm of Simon, Baumann and Buehler. The author saw last spring a plant furnished by them in the Portland cement works of Dyckerhoff and was astonished at the absolute freedom from dust of the milling plants of that large factory. This firm also constructs apparatus in which the sleeves are cleansed by a frame continually moving up and down on the outside of the sleeves, whereby the dust is shaken off.

This device differs in principle from the dust filters in that the dust-saturated air is not drawn by suction through the filters, but is pressed in. The dust-charged air first proceeds into the exhauster and thence into the interior of the filters, while the cleansed air leaves the filters and escapes directly to the outer air. The simplest arrangement of this order consists of a series of long sleeves suspended one beside another, preferably underneath the roof. They are about 30 ft. to 36 ft. in length and 3 ft. in diameter. The dust-charged air is introduced from above, the dust being deposited at the side and drops into bags provided underneath. Each filter sleeve is connected with the common tube conduit through a tube flange and by means of a slide may be disconnected. The sleeves are either knocked out with a bamboo cane once a day from the outside or they are cleansed automatically by a frame sliding up and down. This method of dust elimination is used with the greatest possible success and has besides the advantage of great simplicity. In the cement factory at Offenbach, Germany, still better results are produced by the dust-charged air entering through the first sleeve and passing all of the sleeves consecutively zig-zag fashion from the top to the bottom of the device.

A gigantic plant of this order has recently been constructed by a prominent cement factory in Germany. In a special structure made of corrugated sheet metal and having a height of 45 ft. are suspended no less than 144 sleeves, and in order to obtain more surface calculated on the same space, the sleeves were given a diameter of only 10 in. From each of these filters every day a sack of cement is separated. In the morning and in the evening the filled sacks are taken off and replaced by empty ones. After some preliminary experimenting, the plant now is working to perfection. Owing to the absence of any machinery in this arrangement, there are no repair expenses whatsoever.

On the same principle is based the so-called "Perfection" apparatus made by Rau and Prinz of Milwaukee, but which the author has more often seen in operation in Germany than in America. The construction is as follows:

The dust-charged air, drawn suctorially from the dust sources by an exhauster, is conducted through a pipe conduit into the central drum of the apparatus, in which a great number of radially arranged conical filter tubes terminate. The dust-charged air is distributed uniformly over the whole of the filters and the cleansed air escapes directly into the outer air. The drum is revolved periodically, so that one of the numerous rows of sleeves or tubes always stops vertically above a receptacle in the center. At this moment two rubber hammers beat down upon the row of sleeves, causing the dust to fall off, whereupon it is removed automatically by a screw conveyor from the centrally arranged receptacle. The cleansing of the sleeves, however, is simultaneously effected by the exhauster connected with the receptacle drawing a powerful current of air through the filtering sleeves. The apparatus is constructed so as to allow any deficiency in its functions to be ascertained at once.

In the selection of a filtration contrivance the particular conditions prevailing in the factory installing the device are to be considered. The leading principle in all these dust filters is the advisability of providing as large a filtering surface as possible.

Centrifugal Elimination—The third method of eliminating the dust is based on the utilization of centrifugal force in the shape of so-called cyclones. The dust-charged air is blown tangentially into a cylindri-

WORK UNDER CONSTRUCTION AT SCHERMERVILLE, ILL.
By Stalker & Co. and James H. Flick Construction Co., for the Desplaines Valley Railroad. View Shows a 60-Ton Marion Steam Shovel Loading Westom Dump Cars.

cal sheet-metal receptacle. The coarser parts are thereby flung upon the sides and fall out below at the conically shaped point of the cyclone. The author does not hold a high opinion of the cyclones where they are to serve for the elimination of dust from milling, or packing plants. This opinion is based on observations of such a plant in an American cement factory. The finest dust is not separated, but is whirled with the air current leaving the cyclone, into the outside air.

In the author's opinion a cyclone can be considered only as a preliminary dust collector, provided it is brought in connection with filtering sleeves. Such a filtering apparatus is placed on the market by the firm of Pfeiffer Brothers in Germany, and has proved a success wherever it has been introduced.

Removal of Dust from Waste Cases.

The dust-eliminating apparatus so far described is applied in the suctorial removal of air at a normal temperature in raw mills, cement mills and in the removal of dust from conveying and packing contrivances. The apparatus may also be employed for the removal of the dust from the drying drums for raw material and coal. In these cases, however, two things have to be taken into account: (a) The workman attending to the drying drum must keep the temperature of the escaping vapors high enough to prevent the steam therein from undergoing condensation; he has at the same time to take care that the exhaust vapors always contain sufficient steam and are not so hot as to burn or scald the filters; (b) The casings enclosing the filters have to be made from sheet iron so that in the case of an ignition of the filters the fire is prevented from spreading.

In the writer's experience he has witnessed two such ignitions, and to demonstrate how carefully these things should be observed, one of the cases will be related. A "Perfection" apparatus was installed for the coal mill, which had been placed out of operation from Saturday until Monday and the dust-cleansing apparatus had been put out of commission at the same time. The coal dust adhering to the yet uncleansed filters set the whole apparatus on fire by spontaneous ignition and caused a considerable conflagration. If the cleansing apparatus had been caused to make only one more revolution, so that all the filter sleeves would have been knocked out, this fire could not have originated.

Similar things may occur when the waste gases of the drying drums are conducted at too high a temperature through the filter sleeves. This may, however, be obviated by causing cold air from the free space to be drawn by suction at the same time, prior to the entrance of the hot gases into the filtering sleeves, thereby decreasing the temperature. It goes without saying that in that case the filtering surface must be so much larger according to the quantity of the cold air introduced.

The greatest surety in freeing the heated drying drum vapors from dust can be attained by a dust chamber, which, however, must be well insulated in order to obviate the condensation of the steam. These dust chambers, on the other hand, will prove absolutely unavailable and useless, if they are too small and not properly arranged. In this particular case, the pipe conduit leading from the exhauster to the dust chamber has been laid horizontally, with the result that the pipe is filled with dust in a short time. To overcome this defect the ventilator is run at a higher speed, thus preventing the pipe from being clogged and closed with dust, but at the same time causing at least 5% of the raw material to be carried away through the flue or smoke stack. It stands to reason that the dust chamber is far too small for the extraordinarily strong air pressure; with the high velocity of the air the dust is not allowed to deposit itself in the dust chamber. An inclined position of the pipe would of course have remedied all trouble. The construction of the pipe conduits is of the greatest importance, but this part of the subject cannot be enlarged upon here.

As these dust chambers, however, have to be very large, otherwise there will always be some fine dust carried along, and on the other hand, as the cyclones, which in other respects would suitably serve for heated vapors, fail to give satisfactory results, the purification of the gases from the drying drums has been variously effected and introduced in Europe by water or steam diffusion.

Dust elimination by the wet process will be applicable wherever there is sufficient water available and where the slurry can be used. Such apparatus for the freeing of the drying drums from dust has been in operation in Germany in two of the plants of the company with which the author was connected. The construction which has proved the better and more efficient consists of sheet-metal tubes bent serpentine fashion, at one side of which the dust together with the vapors enters, while at the other side they escape in a purified condition into the free air. In the interior of the sheet-metal tube referred to there are water nozzles rigidly attached, which serve to spray incessantly finely diffused water into the rising vapors. The dust deposited in the shape of slurry flows into a receptacle or reservoir provided underneath the apparatus and is carried uniformly by a pump to the mixing worms, which serve for feeding the raw meal to the kilns, being thus burned at the same time with the raw meal. The consumption of water of such a separator amounts to about 22 gals. per min. The slurry pump has a capacity of 30 gals. per min. The ventilator that draws the gases through the serpentine shaped tube needs but 4 or 5 h. p. for its operation. This apparatus, which was invented by a German machine factory, works excellently, provided the water nozzles are cleansed once a week.

In France a spraying system is employed with success, which is constructed as follows: The hot waste gases enter through a narrow tube from below into a wider tube, in which ring-shaped cells are provided in order to diffuse the gases as much as possible over the cross-section of the tube, thereby preventing them from flowing merely through the tube in the center. At various places in the interior of the tube there are water sprays which are so fitted with small apertures or perforations as to cause the water to be diffused funnel fashion in all directions. The water that has been formed can run off through a laterally disposed pipe.

In a factory on the Rhine the author saw a contrivance in which the ventilator drawing the gases away from the drum serves at the same time to diffuse the water and to separate the dust within its casing. This apparatus works to satisfaction. The wing wheel of the ventilator has scoop rings which are immersed periodically in the water and fling it with great velocity against a very fine wire netting, thereby diffusing it. The gases are thus brought into the most intimate contact with the finely diffused water and the thin-liquid slurry is separated which is carried away laterally. The disadvantages of this apparatus, however, in the author's opinion, consist in the consumption of water being excessive, while the ventilator has of

necessity to be built very stoutly and requires a good deal of power.

If a cement factory is intended to be kept free of dust, it is naturaly of the greatest importance that it should act as a powerful agent in this direction if the production of dust is to be reduced to a minimum. It stands to reason that any dust that is kept away or avoided requires no elimination. In connection with the drying drum a novel device was recently introduced in Germany, which almost precludes the development of dust from the very outset. The development of dust in the ordinary drying drum is caused by the material in the interior being raised to a height of from 4 to 6 ft. by rectangular iron devices and then dropped. In the improved novel construction the interior of the drum is divided into 54 cells. The material, when the drum revolves, is turned over slowly and very little dust is originated. The efficiency of the device lies in the uniform distribution of the heating gases and in the greater surface of the sides. This drum has been patented by a machine factory in Germany.

Elimination of Dust from Rotary Kilns.

The elimination of dust from rotary kilns is particularly difficult in America, because, in contradistinction to the European fashion, individual stacks of but little height are in use. On the other side a whole row of kilns is served by a brick smoke stack of about 200 to 300 ft. The author fails to see any advantage in the use of individual stacks. On the contrary, he is of the opinion that there are a number of reasons why the high brick stacks should be given decided preference.

The most simple contrivance for the elimination of dust from the kilns is the dust chamber with automatic emptying device. In this case, however, the dust chamber is an absolute necessity, even if other contrivances for the purification of the kiln vapors from dust are employed. In the chambers, sieve walls are preferably arranged to which the dust adheres. It has been attempted to purify the waste vapors through filters and for this purpose particular filtering sleeves have been produced from incombustible asbestos fiber material. This mode has, however, not proved a suc-

CONCRETE PAVEMENT.
Bemidji, Minn.

SPREADING MATERIAL IN THE BUILDING OF CONCRETE PAVEMENTS.

cess. Thereupon combinations of dust chamber and certain after-cleansing apparatus have been constructed. In these combined devices the vapors proceed through a dust chamber which is fitted with rocking or shock sides and in which a great portion of the flying dust forced along is separated. In the rear of the dust chamber are provided two water-dust depositors, into which the vapors are uniformly distributed.

In order to render the deposition of dust in the dust chambers more efficacious, particular depositors for the flying ashes have been recently constructed and patented. They are placed in the cross-section of the chamber and compel the smoke vapors to undergo a continuous change of direction when passing through the chamber. These depositors consist of pocket-like pieces of sheet metal which are disposed within the dust chamber.

These devices are in most cases sufficient when applied in connection with the high Eureopean smoke stacks. The very small amount of dust that is still forced along is carried away to great distances and is not observable in the vicinity of the factory.

Utilization of Waste Gases.

The waste gases of the kilns also contain, besides the dust, which can be recovered, another constituent which may be turned into money again. This is the heating value contained in the high temperature of the waste gases. In most factories of Europe and America this heat flies out of the stack without being in any way utilized.

When utilizing the waste gases for drying the raw material the heating value of the same is utilized but half and by the strong draft that is then produced in the drying drums the flying dust of the kiln is joined by the dust developed in the drying drums, which must then be deposited by the application of one of the several methods referred to above, that is, with the very extensive dust-eliminating contrivance. It has therefore been attempted to employ at the same time the same contrivances for depositing the dust that are used for the utilization of the heat of the waste gases. The attempts to attain this purpose originated in America, where the heat of the waste gases was used for producing steam. The first plan of this kind was the steam boiler installation of the Nazareth Portland cement factory, which, however, was not successful. Better results were obtained by Professor Carpenter of Cornell University, but beyond making various trials no tangible results have been produced.

A practical shape was given to this underlying idea in Germany, where several such plants, which at the same time eliminate the dust and utilize the heat for the raising of steam, have been in successful operation for several years. The succession of the several appliances in this plant is: kiln, boiler, dust chamber, smoke stack. The dust chamber here serves for the deposition of the last dust particles. The principal quantity of dust adheres to the tubes of the tubular water boilers and then drops down to be carried away automatically. Of course with the completion of this device extended preliminary experimenting has been necessary and the proper success is solely dependent on the manner in which the boilers are walled in. The dust adhering to the tubes is removed by compressed air, a process which offers no difficulties whatever. Naturally, special precautionary measures are to be taken to avoid a cooling down of the tubes of the boiler when blowing off. The blowing off by means of steam has been an entire failure.

The author regrets that he is unable to present particulars concerning the device with which he is well acquainted, since it is an invention by a cement company which has so far applied this method only in its own works. Certain details may be given, however, in regard to the efficiency of the plant.

One of the principal advantages with this method consists in the flying dust being separated. The heaviest particles, consisting of the already burned and finest cement, drop in consequence of their own weight to the first boiler tube rows and are taken up independently, and immediately added to the cement. It has been demonstrated by examination that the cement gains considerably in quality and strength by the addition of these constituents. The lighter parts are first knocked against the rear rows of the boiler tubes or are deposited in the dust chamber. They consist of underdone cement or raw meal and are burned again. The steam generated by the boilers located behind the kilns is almost sufficient for actuating the entire rotary-kiln plant and the mills in the raw mill. In this plant the waste gases are utilized by 14 boilers, which in turn serve as dust separators. Seven of the 14 kilns communicate with a special stack 300 ft. in height which is connected with the dust chamber located in the rear of the boilers. The boilers situated behind the kilns have themselves no auxiliary firing and are served by two laborers, who have nothing to do but replenish the evaporated water. The evaporation being dependent on the working of the kilns, a special boiler, in addition to those connected with the kilns, which is continually fired, serves to compensate the requisite quantity of steam for the machines. According as the rotary-kiln boilers supply more or less steam, the extra boiler must be fired in a greater or lesser degree. In this plant 60 bbl. of dust are collected daily, a fact which may demonstrate its economical character.

The problem of completely utilizing the waste gases of the rotary kilns and of freeing them from dust is considered solved in Germany. In the place of the ordinary draft furnished by the smoke stack a large exhauster is used for the kilns which draws the waste gases through a system of economizers, steam boilers and superheaters, where they are sufficiently cooled to be blown directly into one of the filter dust-eliminating apparatus. This installation is under construction and the author is unable to present any particulars at this time. The importance of this contrivance is significant in that, on the one hand, the smoke stack becomes completely superfluous, while the gases are entirely freed from dust and the waste heat is utilized up to the highest potency for generating steam.

Economy of Dust Elimination.

In order to demonstrate and to prove what enormous quantities of cement may be saved by the dust elimination in cement and raw mills, an example for practical experience will be given. The plants of the works referred to are fitted with Bett's sleeve filters with which daily experiments and tests were made. This factory has a daily production of 1000 bbl. In one day, i. e., in 23 hours, 3800 kg., or 166 kg. per hr., of cement was collected. As conditions are in Germany, where 100 kg. of cement cost about 75c, the daily gain is approximately $28.50. In the raw mill about 2000 kg. of meal are collected, representing a value of about $6. Hence the daily saving amounts to about $34.50 or $10,350 per year, reckoned as 300 days.

The dust-eleminating plant for this factory had involved an expenditure of $4,500. For power, the annual outlay amounted to $750, and about $250 was

expended for repairs. The expense of the plant therefore was covered by the savings in about 6 months. The quantities of dust that are regained in a dry state by the application of the dust filters amount to from 2 to 4% of the entire output.

These results were produced in a Silesian factory by the aid of Bett's filters. A second instance of the practical working of a slag cement factory is one in which dust filters from the works of Simon Buehler and Baumann are in operation with the best success. In this factory which has an output of 16,500 tons, a yearly saving of 495 tons was effected in cement meal alone, by means of the filters, which, at the rate of $4.50, amounts to $2,250. This quantity of recovered material would otherwise have been lost as waste material. This instance may serve as a computation of rentability for the purpose of demonstrating how excellently such plants make themselves pay.

The gain that is open to proof is thus demonstrated in black and white. But an advantage or gain of at least the same value is involved in various other circumstances, with which a rationally applied dust-eliminating plant, offer considerable economical advantages.

Above all, it must be mentioned that the working power of the mills will be perceptibly increased if the heat produced by the disintegration of the never entirely dry limestone, cement clinker and steam is carried away.

Furthermore, by dust elimination the depositing of the dust on the machinery is avoided, whereby the wear and tear of the same is considerably reduced. It is less the raw meal than in a far higher degree the cement meal that produces wear on the rotating machine parts, in the manner of emery, more particularly when it has access to bearings which can never be so protected as to be entirely dust tight. There is not the least doubt that the superintendence and the tending of the machine plant are also materially facilitated in avoiding such disturbances.

In conclusion, it may be mentioned that the health and life of the laborers working in cement factories speak forcibly for the introduction of dust-eliminating plants, while they offer in addition the advantage of having and obtaining steady and more cheerful workers.

The author believes that he has treated the subject sufficiently to demonstrate that the dust-eliminating problem merits close attention, and that all cement factories will have to concern themselves with this problem for economical reasons. If a factory having a daily output of 1000 bbl. saves upwards of $10,000 a year by recovering the otherwise lost dust from the raw and cement mills, the great losses accruing to factories producing 5000 or 20,000 bbl. per day may be easily calculated. Furthermore, if it is considered that by means of suitable contrivances the whole of the dust and the high waste gas temperatures which now escape from the stacks of the kilns can be utilized to advantage, it cannot be regarded as an exaggeration that in the American cement industry many hundred thousand dollars are wasted and squandered every year, and that at a time when the price of cement has fallen to a level leaving hardly any margin for the manufacturer.

The Wilson Reinforced Concrete Co., Nebraska City, Neb., will build a new concrete bridge over South Table creek on Ninth street for the county commissioners. Cost $10,000.

DEDICATION OF SPOKANE'S NEW CONCRETE BRIDGE.

National, state and municipal officials, engineers of prominence in America and Europe, and visitors from many localities in the Northwest joined with the residents of Spokane in the dedicatory exercises incident to the formal opening of the Monroe Street bridge. The structure, which is of concrete, with a center arch of 281 feet, the largest of its kind in the world, was built by day labor at a cost of $500,000. Business property valued at more than $1,000,000 was reclaimed by the city at the south abutment, which is within four blocks of the banking center.

The structure was designed by J. C. Ralston, member of the American Society of Engineers, formerly head of the Spokane engineering department, and built under the supervision of City Engineer MacCartney. The new bridge replaces a steel one of 1,300 feet, consisting of a cantilever main span, approached by truss spans and a trestle, which proved too light for street car and other heavy traffic after being used about eighteen years.

J. C. Ralston, Designer of Spokane's Great Bridge.

The bridge spans the Spokane river at the lower end of the falls, where the drop in a series of cataracts is 136 feet within a length of 1,300 feet. The river has a flood flow of 40,000 second feet and 2,000 second feet at low water flow. The down-town streets on both sides of the river are not more than ten feet above high water at the crest of the falls, but within four blocks it drops into a gorge 140 feet in depth and 1,500 feet in width at its top. The structure is 791 feet in length with a 50-foot roadway, the difference between it and the old bridge being made up by an earth fill, requiring more than 1,000,000 cubic yards of material, furnished from the deck of the old span and down-town excavations.

The new structure carries a double-track electric car line and a highway and has two 9-foot cantilevered sidewalks. It consists of a middle segmental span of 281 feet, two 120-foot semicircular spans, a

100-foot semicircular span, a retaining wall 93 feet in length with a maximum height of 53 feet. The main arches are not reinforced, but others are either of concrete reinforced with rods and wire mesh or of structural steel encased in concrete.

When the new bridge was first discussed by the city council, in 1908, it was intended to erect a structure of 1,300 feet, costing $750,000. A year ago, however, it was decided to build in the near future a 4-track steam railway with flanking electric car lines and streets crossing the line of the bridge at a high level, taking in space nearly 700 feet north of the old south abutment. This projected construction necessitated starting the new bridge a distance north of the old span and also required that ample clearance be allowed for railway tracks.

The result was a saving of $250,000 to the taxpayers, as against the structure of greater length, and, in addition, it has resulted in the creation of some highly desirable real estate, estimated to be worth more than $1,000,000, which has accrued to the city. Every dollar's worth of work was done by day labor, the city paying $3 for a day of eight hours to ordinary laborers and the regular scale to skilled workers. The city bought all the materials used in the open market, and thus saved a large item of the usual expense of municipal work by contract.

SPOKANE'S GREAT BRIDGE JUST COMPLETED.

USE OF CONCRETE IN PRESERVING PILES EXPOSED TO SEA WATER.

By C. C. Horton.

It has long been the aim of engineers and builders to find some method of treating or protecting wooden piles or other wood structures from the destructive attack of marine borers, of which the teredo and the limnoria are the chief representatives. Many methods have been tried, and success more or less marked has attended some of them. The principal methods are the chemical treatment of the wood fiber and the mechanical protection of the pile or timber by a protective covering of metal, treated wood or concrete. However, we are interested only in the application of concrete or cement and will pass over the other methods with but brief mention.

Under the head of "chemical treatment," creosote should be given first place. This proves very effective until by abrasion or dissolution, the pile loses its sheath of impregnated creosote and becomes open to attack by the destructive ship-worm. A pile so treated is effective for approximately fifteen years, if it has received no mechanical injury to split or otherwise damage it.

We shall now consider the concrete covering of wooden piles, of which there are quite a variety and several classes, and we shall endeavor to describe several, which are more or less practical. We shall classify them "A," "B," "C," and "D," merely to distinguish them and not according to their relative merits.

CLASS "A." A wooden pile covered with a jacket of concrete, made by placing a mold around the pile and filling with concrete reinforced with steel or not, as desired, applied before driving. This makes a pile that can be inspected without trouble, but has the drawback of being heavy and difficult to handle and drive. It will sink, presenting the same difficulty as a solid concrete pile in this respect. Furthermore, the same precaution must be observed in driving it as in the purely concrete pile. It is difficult to give exact costs as these will vary with the size of the pile, the length covered on each, the varying cost of materials, the proportion used in the concrete, the use or omission of reinforcing, cost of labor, etc. We shall endeavor, however, to give a relative cost of the several methods, so that a comparison of the various classes may be made.

CLASS "B." This class includes piles covered after they have been driven and before the superstructure has been built. The covering is applied by lowering over the pile a continuous concrete wood or steel jacket, so proportioned as to leave an annular space between the pile and jacket of from two to four inches, preferably the latter; this space is then pumped out and filled with concrete.

This method presents some difficulties where deep water is encountered, due to the liability of the jacket to collapse, if built of wood or steel. Furthermore, it is difficult to exclude mud and water if the sea bottom is soft or if the casing is not perfectly tight. It is sometimes found necessary to seal the bottom with cement and allow it to set before pumping out the annular space. This pumping out should be as complete as possible for the best results.

CLASS "C." This is a modification of class "B" in that it uses the same type of jacket, with the exception that it is made sectional and in two parts to admit of its application to wharves already built or where the superstructure is in place. A tile jacket is sometimes used in addition to the others of class "B."

The jacket is applied by placing the sections around the pile and is lowered section by section, by suitable means, until the submerged portion of the pile is covered and sufficient penetration is obtained into the sea bottom; the annular space is then filled with concrete without first pumping out the sea water. With this style of construction, it is impossible to exclude the water and mud, which is a serious drawback. The concrete is liable to be be of inferior quality, especially at the bottom, the very point that should be made the most impregnable, the mud line being the principal point of attack of that most destructive of wood borers, the teredo.

CLASS "D." This is of more recent origin than any of the previously described methods of armoring. It consists of a light steel sectional jacket, fitted at the bottom with a self-adjusting diaphragm, made to accommodate itself to the irregularities of the pile. The method of procedure is to fit the bottom section containing the diaphragm around the pile and fill with concrete, the section being suspended from above by suitable means, usually by winches. The first section is then lowered sufficiently to permit the addition of another section, which is filled with concrete; this is repeated until the submerged portion of the pile is covered and the desired penetration is obtained into the sea bottom section containing the diaphragm around the jacket should be at least four inches, and in large piles of say eighteen to twenty inches, five or six inches.

This method renders the concreting of piles very simple and effective and obviates the principal difficulties of the three other classes of covering. It is especially adapted to the repair of old wharves, badly eaten by either the teredo or the limnoria. The San Francisco harbor board has adopted this latter method for the repair of its old wharves, and finds it economical, easily applied and durable. Classes "A" and "B" are not suitable for the repair of old wharves, the expense being prohibitive. Between class "C" and "D" the latter may be applied for approximately 20 per cent less per linear foot than the former.

For new work, classes "A," "B," and "C" would cost approximately the same, with a slight possible advantage in favor of class "A." Class "D" may be applied to new construction more cheaply than on repair work, and would run 20 to 25 per cent cheaper than any of the other methods.

The San Francisco harbor board is paying $1.55 per foot for class "D" work on all sizes of piles. This includes profit and royalty, the actual cost ranging from $1.00 to $1.25 per linear foot.

PROFIT SHARING WITH A QUARRY COMPANY.

The Charles Warner Company, of Wilmington, Del., which operates extensive limestone quarries at Upper Merion, Cedar Hollow, Devault and Plymouth Meeting, Pa., are about to inaugurate a profit-sharing plan with their many employes. The announcement was made by Mr. Charles Warner at the annual banquet given to its principal employes in Wilmington. Mr. George W. Perkins, formerly a partner of Mr. J. Pierpont Morgan, who is devoting himself to advancing profit-sharing schemes, was the guest of honor at the banquet.

SAND AND GRAVEL WASHER.

As every worker in concrete knows, or should know, nothing is so important as clean sand and gravel, and these are often hard to get. There is a machine for washing sand and gravel that has solved completely this problem for every concrete man. It is made by the Stocker Concrete Material Washer Company.

The Stocker Gravel and Artificial Stone Company has been operating for years, and, feeling the necessity of a device to clean gravel and sand, Mr. F. Stocker undertook to construct one and finally succeeded in inventing the machine, thereby supplying a want generally felt in the concrete industry.

This machine has been tried thoroughly and found to be practical and advantageous in every respect. Its construction is very simple and strong, most durable and comparatively cheap. It can be readily operated by anyone, since there are no complicated parts to get out of order.

The machine can be easily transported from place to place if desired. This feature is particularly advantageous in case of bridge building, pier and abutment work; in such case the machine can be moved to creek or river bank, where sand and gravel can be found in abundance nearby, however usually too much mixed with mud, dirt or other impurities to permit their use; but if washed right on the spot the cost of hauling the mtaerial from a distance, sometimes for miles, is saved.

The washer is all metal, the end frames are cast iron, the revolving drum is of No. 16 sheet steel, on the inside of the drum are riveted angle iron bars, to which steel strips are riveted, forming an elevator carrying the material to the upper part of the drum, whence it drops into steel chutes, which are stationary and at a fixed angle, conveying the material forward; from the chute it falls into water at bottom of the drum, taken up by the elevator and dropped into the next chute and so on until the washed material finally is discharged from the last chute.

The machine can be operated with a 2-horsepower gasoline engine, is well made, strong and durable.

The capacity of the machine is about 75 tons per day of 10 hours, washing sand and gravel containing 20 per cent of clay (result of actual tests), and will require only from 10 to 15 gallons of water per minute. Then, too, the price is within the reach of all. Cement and Engineering News will be glad to furnish catalogues of this washer.

TILE MACHINE BUILT ON A NEW PRINCIPLE.

Most tile machines are built on what may be called the "overhead" principle. Mr. W. E. Dunn, of the W. E. Dunn Mfg. Co., Chicago, has developed a tile machine on an entirely different principle from any ever attempted before. His machine is extremely compact, requiring unusually small floor space. Only three shafts and two sets of gears are necessary in this machine to make concrete tile at a faster rate than any one man can take them away from the machine.

When run at its full capacity for one whole day, it will deliver 2,000 complete tile.

All simple things are more wonderful than the more complicated ones; and the wonder is: Why didn't some one think of this form of tile machine before?

Mr. Dunn will gladly send a catalogue describing this machine to anyone who is interested.

Right and Wrong in Gravel Washing

Perhaps nowhere could there be found a better example of importance of careful attention to the conditions to be met in even the seemingly simplest of work, than at the plant of Gallagher Bros. Sand & Gravel Co., Port Washington, Long Island, N. Y. A gravel washing equipment installed here a year ago fell so far short of satisfactory performance as to cause its abandonment in favor of a new and totally different outfit, applying the Webster method.

The Gallagher brothers—John J., Peter C. and Frank F.—handle the three very necessary corners of a big business in supplying sand and gravel to contractors and constructors of New York City and vicinity. John operates the plant, Frank runs the home office, and Peter attends to the sales work in the big city.

In 1909, when former banks at Manhasset became exhausted, the present property of nearly 300 acres in sand and gravel land, was acquired, on Hempstead Harbor inlet, 5 miles from Long Island Sound. Here there is about 9 ft. of water at high tide; at low tide the boats at the shipping dock, Fig. 1, settle in the mud to await the return of the waters.

The plant installed was designed for a capacity of 3,000 cubic yards per day of ten hours, but the gravel washing portion was so unsatisfactory that it not only failed to attain this capacity, but would not do its work well at all, even at a much lower rate of operation. The screens were not adapted to the nature of the materials to be handled here and were of entirely too small capacity.

So the Webster Manufacturing company, Tiffin, O., was called upon to investigate the situation and recommended the proper remedy. The results of this action are now embodied in a new and perfectly adapted gravel washery, built adjacent to the unsatisfactory and now abandoned original, as shown in Fig. 9.

The working equipment now consists, therefore, of the sand plant, on the left in Fig. 3, and the gravel washery, on the right. Between these two, in Fig. 3, appears the abandoned gravel plant. The material is brought from the rear of the plant, where it is loaded into dump cars by steam shovels, in two pits, Figs. 2 and 3, which gradually will work together into one. Steam locomotives haul the cars in pairs to a track hopper, where their loads are dumped for delivery to the sand house.

Separation is made into four grades—dry-screened sand, washed sand, torpedo sand, and gravel.

Material carried to the top of the sand house is passed dry over 3/16-in. gravity screens, the fine material dropping into pockets beneath. The coarser parts, gravel and boulders, are chuted to a hopper feeding a 24-in. belt conveyor leading upward to the top of the washing plant, where delivery is made into a receiving hopper. Water from a large duck-bill nozzle flushes the material into and through the screens.

The screens are cylindrical type, 48 in. by 16 ft. in size and twelve in number, arranged in four sections of three each. As shown in Fig. 7, only two sections have been placed. The other pair will be erected later, together with a 24-in. Webster belt conveyor to bring material direct from the bank. Then the washery can be fed from the sand house or from the bank, or both, giving any desired proportions of dry and washed sand.

Fig. 7. Looking Down On the New Washery from the Old One.

The material passing through the first screens, with their ¾-in. perforations, is flushed into the second or ¼-in. screens, the rejections from which are spouted to the gravel pockets. Similarly, the third screens, ⅛-in., take out the torpedo sand and pass the fine sand and water on to settling tanks, whence the water is drained away to waste.

Boulders tailing from the ¾-in. screens are chuted to the crusher, Fig. 5, where they are broken and dropped into a hopper which feeds a belt conveyor leading back to the top of the sand house, whence the material goes again to the screens.

At lower ends of second and third screens are back-jets of water which are very effective in cleaning and brightening the gravel and torpedo sand as they tail out. In the chutes to the pockets are placed perforated metal screens on which the material is retarded to drain away the water.

Power for the gravel washing is supplied by a Web-

Fig. 1. Loading Dock, Hempstead Harbor.

Fig. 2. Digging Sand and Gravel from the Bank.

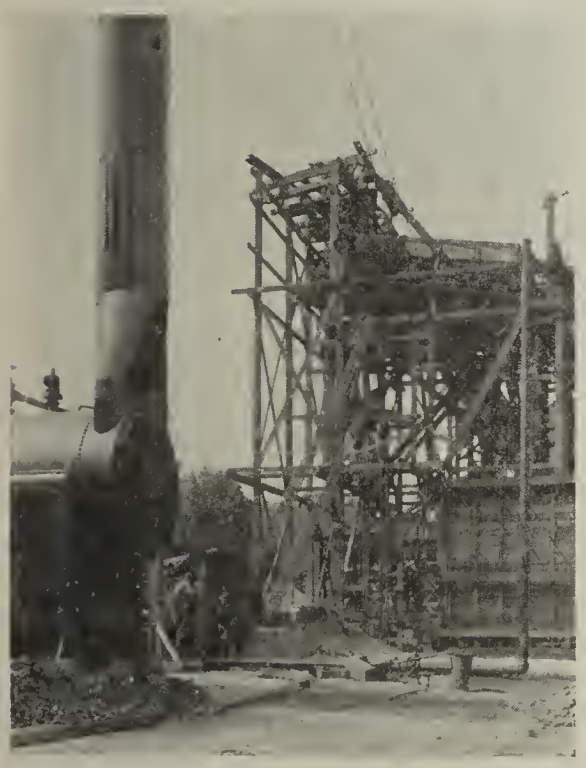


Fig. 4. Rope Drive to Washing Plant.

Fig. 3. The Plant as Seen from the Bank.

Fig. 5. Crusher for Reducing Boulders.

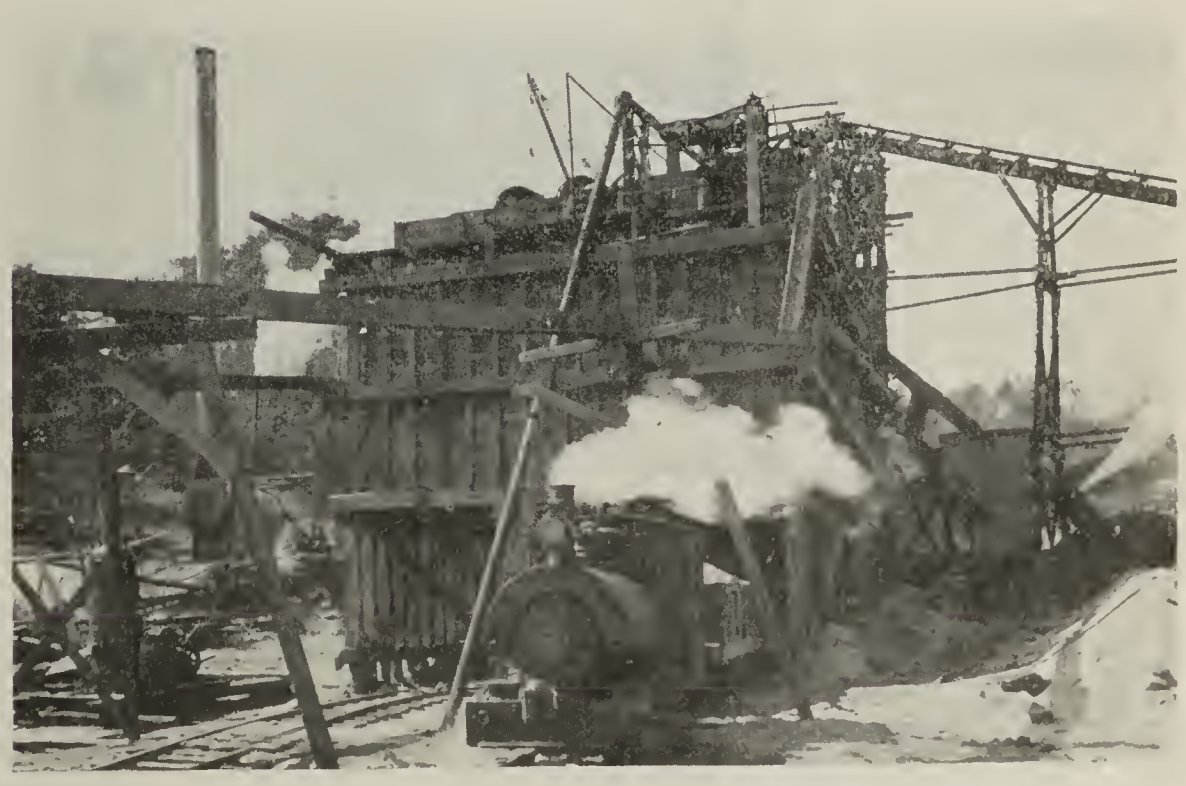


Fig. 6. Hauling Washed Gravel to the Loading Dock.

ster Method rope drive from a 100-h.p. steam engine, with boiler, Fig. 4. The ropes are guided over idlers for fair lead to the driven sheave on a jack line, from which distribution is made to conveyors, screens, crusher, etc.

Water for the washery is delivered by a triplex pump, with steam engine and boiler, in a pump house at the creek passing the plant.

Fig. 8. The Cylindrical Screens, 3/4 in., and 1/8 in.

By side bin gates at the sand house, and double undercut gates beneath the washery, the materials are dropped into dump cars for hauling by steam locomotives, Fig. 6, to the shipping dock, Fig. 1, whence scow loads are towed to contractors or dealers.

Aside from the stationary plant, the company's equipment includes four 12-ton steam locomotives, two steam shovels, 25 dump cars, 18 scows and a towing tug.

The Webster installation proved to be admirably adapted to the work and its daily capacity exceeded all expectations, whereas the plant which it replaced was utterly insufficient and inefficient. The screens in the original plant did not clean enough, nor well enough, and on a recent contract for government work on the new dry dock at the navy yard in Brooklyn, the product was so unsatisfactory as to be rejected by the inspectors, forcing Gallagher Bros. to buy elsewhere large quantities of passable materials.

The new Webster installation was rushed to completion and started in June last, in time to make satisfactory deliveries on the last of the navy yard job. The separations made by the Webster plant were so sharp and the sand and gravel so thoroughly cleaned, that the material was notably superior to what had been purchased elsewhere, so that the showing made by the Webster plant in the first few weeks of its operation was the means of securing the contract for the entire requirements of the high-pressure tube work on the new Hudson River aqeduct. Thus did a timely application of the Webster Method turn a discouraging failure into a gratifying success.

Fig. 9. The Busy New Washery and the Abanded Old One.

The Relation Between Engineers and Contractors On Highway Work*

I take it for granted that past and present methods of building and caring for our roads are acknowledged to be unsatisfactory, and that the object of the American Association for Highway Improvement is to alter or to abolish these methods, and to replace them with better ones. In other words, we must substitute efficiency and economy for failure and waste. We have, as the result of experience in other classes of public work, demonstrated that the success of contract work under the direction of engineers is as applicable to road construction and maintenance as it is to other works, and it has some special advantages which will be explained later.

The Road Engineer.—In the first place, road work should be under the direction of an engineer; because the kind of work to be done, the quality of the work, the amount of it, and the method of doing it, should be determined by an expert. But suppose the engineer is not an expert, what then? Do not be influenced by any such supposition. Work from knowledge, and employ an engineer who is a road expert. There are engineers who are road experts, and there will be many such engineers developed as correct methods are adopted for road work. As the demand arises, the supply will arise to meet it. In any case, whether the work is performed under contract, or otherwise, the road engineer is necessary.

The road engineer should know just what is needed. He should be able to plan and describe these needs so that they are clearly interpreted to those who do the work. He must make his plans to conform to the funds provided to pay for the work. He should possess exceptional executive ability, for in his occupation there is an unusual spread of responsibility for the work itself, and for the number of interests which must be considered. Technical knowledge, good judgment, and tactfulness are all essential qualities which he is expected to possess. His field of action is most attractive, for the reason that half of his problems are already solved. Experience is principally gained by the study of failures, and a knowledge of what has been so poorly done in the past will teach him what must be avoided in the future.

To improve the roads in any specified locality requires first of all a head to plan and to supervise the work to be done. This head, whom I designate as the road engineer, must be responsible for all the work in his district, and since responsibility cannot be dissociated from authority, he should have full authority over the conduct of all the work for which he is responsible to the power that appoints him. The engineer must not be hampered in his work by any other consideration than the performance of his duty as engineer. He should have no affiliations and should eschew politics, knowing all men only as citizens with a common interest to be served by him.

A word of warning here for those who have the power of appointing the engineer—scarcely anything can be more subversive to the public good than to make a political appointment of such an office. The engineer should be chosen as an expert in his line of work, which leads to the conclusion that his office should be an appointive rather than an elective one. His appointment should be after careful examination of his qualifications for the office, and this can only be made by an appointing power, which is capable of determining his fitness and which is responsible for the performance of his duties.

The Road Contractor.—In the second place, road work should be done by contract, because if we are expected to improve our roads, we must make a business of road work, and since the contractor is in that business, we need to engage his services. No better argument can be made in support of this statement than to call attention to road work which was not conducted as a business, and which was performed by men whose business was not that of road making. A road contractor should know his business. He should know what constitutes a good road, and how to build it. He should be provided with tools and implements required for road construction and maintenance. If the road contractor follows road building as an occupation, it is expected that he will have such plant as will enable him to execute work of the best character, with economy of cost in money and time, and that he will have a following of workmen familiar with road making. We may reasonably expect that road work will be done by a competent road contractor with greater economy and despatch than can be attained under a system where a local government undertakes to buy plant and employ men with which to do its own road work.

The engineer plans and supervises the work, gives instructions to the contractor, inspects material and workmanship, and makes the contractor's estimates for payment. Contracts should be awarded by the engineer, or upon his recommendation. In general, the engineer directs the work and is responsible to the power which appointed him for the performance of all of the contractor's obligations. The contractor, on his part, must comply with all the requirements of the contract, and to this end should be directly responsible to the engineer.

The Contract.—Thus it rests with the engineer and contractor to get the best roads possible with the expenditure of the people's money. It is obvious that they must pull together or the people will be losers. Their relations are defined in the contract for the work. In the ordinary forms of contract for work to be performed, the engineer is vested with full power of directing the operations of the contractor. The engineer makes the estimates of quantities and of values, upon which the contractor receives payment. It is his duty to fix the standards for material and workmanship, to inspect the quality of materials and of work, to accept such as conform to the contract and to reject such as do not meet the contract requirements.

Nearly all contracts give the engineer arbitrary power to decide all questions arising in the performance of the contractor's obligations, and most contracts state that the decision of the engineer shall be final and binding on the contractor. These powers conferred on the engineer appear to be the outgrowth of experience and are perhaps warranted by expediency. For so long as the engineer is competent and fair, the system works very well, but engineers have the qualities common to humanity and it would be fairer to them if the provisions of a contract confined their decisions within the limits of justice. Experienced contractors sometimes find that contracts which they must accept, or go without the work, give the engineer such an advantage over them, that they attach more importance to the personality of the engineer than to the terms of the contract.

Speaking from experience both as an engineer and

*A paper read before the First American Road Congress at Richmond on Nov. 21, by Onward Bates, past-president of the American Society of Civil Engineers.

as a contractor, I do not favor vesting the engineer with arbitrary power over the contractor's interests. We live under a constitutional government, and contracts between its citizens should preserve the constitutional rights of both parties. A contract which enables one party to work an injustice upon the other is contrary to public policy, and whether it be legal or not, it conflicts with the principles which all of us claim as citizens. I believe it is possible to draw contracts which will secure the faithful performance of the obligations of both parties, and will at the same time protect the interest of the party at whose expense the work is carried on.

Under a general system of road improvement throughout the country, equitable forms of contract will be developed which will supersede forms that are found in practice to be objectionable. Bring together the expert engineer and the competent contractor, and it will be found that they can work together in harmony and obtain the best results for the community which employs them. In most cases of trouble between the engineer and the contractor the fault lies with one or the other, or with both of them. It would seem almost superfluous to make the statement that the best form of contract is that which covers the obligations of both parties in the simplest and plainest terms, leaving out all unnecessary language. And yet it is well to be reminded of this, for many contracts for performance of work are so unintelligible that both engineer and contractor find it difficult to decide what are their respective obligations.

The Specifications.—Specifications for material and workmanship are usually attached to and form a part of the contract. The preceding remarks favoring brevity and simplicity in the working of contracts apply with equal force to the specifications. Instead of trying to include in the specifications everything under the sun, it will be better to omit from the contract all items of uncertain and indeterminate character, and this will avoid the necessity of describing and specifying their value and extent.

In the interest of economy and efficiency the work should be classified and grouped in the most convenient manner for letting it by contract. The work should be of such character and volume as will enable the contractor to make favorable prices. The engineer should also try to arrange the work so that a contractor may work continuously through the working season. The expenses of organizing and starting work are understood, and should not be repeated any oftener than is necessary. Changing contractors or employing them at intervals of time involves what may be called "contractor's terminal expenses," and if these can be avoided there will be a considerable saving in cost which should be recognized in the contract prices and the saving divided between the parties. Better prices for work and better service will be obtained from an established local contractor who, in looking to the work as a means of livelihood, desires to retain in his service experienced workmen and to keep his plant employed, both of which are necessary for economical operations, and he will thus be in a position to make more favorable proposals for the work than when making ventures with scattering bids in various localities and with unfamiliar conditions.

Contract and Day Labor.—In advocating the contract method of doing road work, I recognize that some work can be more effectively handled by day labor or by special arrangement. There is a distinction between road-making and road-maintenance. The former may be classed as intermittent work, and the latter as continuous work. Maintenance and repair work will frequently be of such a nature that it cannot be advantageously contracted for, and the engineer must provide for this class of work by day labor, or by some method which is suggested by his experience.

A REINFORCED CONCRETE GARAGE FOR HUGUELET BROS., Chicago.
Marshall & Fox, Chicago, Architects. W. P. McEvoy & Co., Chicago, Contractors.

In general, it is better to contract for all work which is adaptable to that method. The engineer's operations may cover an extended field and cause him to be unable to supervise the work personally, in which case his inspectors or other assistants must act for him, and they can be better employed in controlling results of work done at the contractor's cost than in becoming responsible for the value of work done by the engineer's employes who may be so scattered that the cost of supervision will equal the wages paid to the workmen.

Another reason for avoiding the direct employment of workmen is that it means the purchase of tools and implements for the workmen, and this will always be unprofitable unless there is sufficient work to wear them out. There is scarcely a worse investment than a contractor's outfit which is not employed.

Guarantees.—It is not uncommon for a contract to specify that the contractor shall guarantee his work

for a certain period of time, sometimes reaching into years. There may be cases where a contractor's guaranty is justified, but it is a questionable practice. Competent engineering will require and secure good work. When a contract is completed, the engineer should know that the contractor has given the full value of work specified in the contract, and he should be in a position to pay that value in full. The engineer's employment should be continuous. He should be a permanent officer of the local government, responsible to his superiors for construction and maintenance of the roads. This responsibility, as has been stated, should clothe him with the authority necessary to secure the ends he is employed to attain.

Since the engineer is the official who makes the plans and controls the execution of them, while the contractor works under his instructions, subject to the terms of the contract, any suggestions as to road making should be addressed to the engineer, who will communicate to the contractor as much of them as is necessary in carrying out the work. I purposely avoid mentioning details of contracts, plans and specifications, all of which the engineer must fit to the particular problems he is called on to solve, but in a general way, I venture to suggest some of the elements of road engineering necessary to be observed in his practice.

Financial Considerations.—He must always maintain an equilibrium between the amount of work he plans to carry out, and the funds available to pay for this work. The kind and amount of work will be limited by the sum appropriated for its cost. He must decide whether the limitation shall be placed on the kind or the volume of the work. As a general proposition the character of the work should be uniform. To secure this he may have to sacrifice his ideals and fit the character to the circumstances controlling the case. The efficiency of a road is determined by the tonnage hauled. For a given distance of haul, unless the road is of uniform quality, the haul will be limited by the worst portion of the road. There is therefore such a thing as making the road, or at least a portion of it, too good, if the funds are not within sight to bring the whole distance to the same good quality.

In a rich and populous state where the people have awakened to the necessity for good roads and contemplate the expenditure of many millions of dollars to secure that end, it is very well to say, "we will build no cheap roads," and to fix a standard of $5,000 or $6,000 per mile for construction. On the other hand, in the case of a state with a population of less density and with a much smaller provision of funds, and yet with, say, 80,000 miles of highway within its territory, it would be folly to adopt such expensive construction. This wonderfully prosperous country owes this prosperity more to its development through the construction of cheap railways than to all other causes combined. The economic results obtained by cheap first construction in order to provide intercommunication through a great area have been demonstrated beyond question in the case of railways, and the principle has equal application in the matter of highways. The improvement of highways is not to be accomplished by spending all the available money in spots. These highways are for the whole people and all of them are entitled to benefit by the expenditures. Improve the conditions of communities by giving them the best roads they can afford at the present time and the resulting increased prosperity will provide the means for bringing them to the desired standard. The kind and amount of road construction depend upon conditions, and should be determined by the exercise of good judgment on the part of the engineer.

Maintenance.—He must also arrange to maintain the standard of quality planned for its construction. This means constant attention and repairs to meet the deterioration resulting from wear and weather effects. The old adage of "a stitch in time saves nine" is nowhere more applicable than to road maintenance. This is a most important consideration, and it emphasizes the requirement that the office of road engineer should be a permanent one. The maintenance of roads requires a knowledge of all the conditions affecting

CONCRETE BLOCK RESIDENCE,
Mitchell, S. D.

Dr. R. C. Warney, Mitchell, Owner. Wherrey & Happe, Mitchell, Architects.
G. Scheurenbrand, Mitchell, Contractor.

them. The engineer stands toward a road in his care as a doctor does toward his patient, and to diagnose the case of a road, the engineer must feel its pulse, take its temperature, and learn all about it. A helpful and satisfactory way of doing this is to keep statistics of work done, of cost of repairs, and of the times and seasons of treatment. These statistics can be diagrammed so that the engineer may, with a hasty glance, read the record and learn both what has been done and what is needed to be done.

The road engineer will in the future be judged by his performance, as compared with what is accomplished elsewhere. If a system of good roads is promoted throughout the country, there will be precedents and new records established for road work, in kind, quality and cost, which will, from time to time, fix new standards in these respects.

The Field of Road Improvements.—It may appear that my remarks about the duties of engineers are out of place in a brief address on the relation between engineers and contractors, but I have made the digression advisedly, as I will now try to explain. A fair consideration of the work and duties of the road engineer will bring many of us, who have practiced the profession in other lines, to the realization of the great field of employment opening to us in this particular class of work. The practice of the road engineer will require knowledge, skill, experience, judgment, and business qualities, of high grade, which will lead many of us to engage in this special line of work. This will benefit my profession and also the nation.

For the contractor there will be provided a steady and profitable business, which from its nature can be conducted in a moderate way with small capital, a most desirable condition in these days when there is so great complaint about the monopolization of business by combinations of capital, which closes doors of opportunity to men of small means with capacity to work for themselves. The time is auspicious for the road engineers and the road contractors. This Congress and the Association which called it will make their mark on our nation throughout all its confines. It may not be today nor tomorrow, but the American people, when they have set their minds on the acquisition of good roads, will have them. With our people, to will is to do, and it appears that we have the will.

The American Association for Highway Improvement will provide a medium of communication for engineers and contractors, and I look toward the future and see conventions of them discussing plans and methods, as is done in the great railway associations. The associations of railway engineers, of superintendents of bridges and buildings, of master mechanics, and of master car builders, have in their meetings within a few years achieved a uniformity and excellence of practice which appears marvelous to those familiar with the practice not many years ago. Such meetings of road engineers and of road contractors will result in satisfactory forms of contracts, specifications, plans, methods and cost, for building and maintaining roads which will be profitable to them and far more profitable to our citizens who must bear the cost of all such work.

RESIDENCE OF ARTHUR B. SHEPLEY, WESTMORELAND PLACE, ST. LOUIS, MO.
Medusa White Portland Cement.
Mauron & Russell, Architects. W. M. Sutherland Building & Construction Co., General Contractors.

EGYPTIAN PORTLAND CEMENT CO.

The Egyptian Portland Cement mill, Fenton, Mich., and the real estate holdings of the company were disposed of at public auction in Flint Tuesday afternoon by Circuit Court Commissioner Marshall Frisbie. The plant was purchased by a committee representing the bondholders for $180,000, the equity of redemption selling for $5.00. The mill was erected about ten years ago at a cost of over half a million dollars and is said to be one of the best wet process mills in the state. The company have made plenty of good cement but have lacked working capital, and the financial difficulties in which they became involved brought about the appointment of Edward C. Forte as receiver. When in operation, employing about 150 men, this plant was one of Fenton's best assets, and the people of the village hope that the new purchasers may be able to make arrangements, whereby the plant may again be started.

Uses and Misuses of Concrete and Reinforced Concrete

By DeWitt V. Moore

Misuse implies abuse, misapplication and waste, whereas use, in its full sense, means the full utilization or application in actual use without waste; in other words, use in the sense of an intelligent, proper adaptation. If there is any other building material which is misused as often as concrete, when viewed from this standpoint, it does not occur to the writer. Many times a use of concrete is a misuse or abuse, and on the other hand, many times an abuse of concrete is in the end a practical use of same.

I suppose most of you present have given the subject of the peculiarities of concrete considerable thought, for really it is a very extraordinary material in construction.

In the first place, a material which can be poured into moulds when of the consistency of soup, and yet solidify and become the same as stone, is certainly an adaptable type of construction and one which prompts the designer and the contractor to abuses.

While from the strict use of the English language we should speak of use and misuse, still, to carry out the idea we have in mind it seems more proper to say use and abuse.

The architect who lacks enthusiasm with regard to the use of concrete, and therefore does not follow the full working capacity that he should, is abusing this material.

We next consider a direct abuse by the overzealous, who expect more from this material than is reasonable or based upon good practice. A designer of this class will overstress his concrete and understress his steel, or overstress both. This is a direct abuse of the material. Somewhere between these extremes lies a proper use of concrete and reinforced concrete.

I am not presenting for your consideration a technical paper for the purpose of promoting any special ideas as to design, formulas, percentages of reinforcement, special types of reinforcement, or advocating any stresses to come on either material.

As a matter of common sense, let us consider that with the extreme case of a lean mixture of concrete we have nothing but a pile of gravel and sand, possessing no compressive strength whatever as concrete, and forming no bond with the reinforcement therein. On the other hand, to go to the other extreme, we could mix a batch of neat cement which would possess great strength, but the most of this mixture would be prohibitive.

A mixture of gravel or stone, sand and cement, which provides a solid, homogeneous mass, may be safely relied upon, when given the proper working stress according to proportions, rather than to abuse the material by the addition of more cement on the theory that the corresponding increase in strength will justify the cost.

With this idea in mind, what is the necessity of specifying a 1:2:4 mixture of concrete for heavy monolithic walls, footings or foundations for sidewalks and ground floors?

This thought leads us at once to a consideration of alternate designs, viz.: Where the architect, being perhaps favorable to wood or steel only, allows the concrete construction to compete under the same loading conditions as for the other materials. We design for strength, but with a proper regard for stiffness. Using the ordinary tables for steel and wood, the concrete, if properly placed, will have three to four times the stiffness, and, in addition, will only fail, and that gradually, under a load two or three times as great as will cause disaster in the other materials. Under these conditions, should not the specified load be less for the concrete, resulting in a competition on a fair basis?

A concrete wall need not necessarily be of an extremely rich mixture, if it is for a heavy bearing wall, and therefore an excess of strength and resulting cost due to the specification of a rich mixture is an abuse.

A specification for a reinforced concrete structure under the same conditions, where, through force of habit and experience, the proper working stress is placed on the steel reinforcement, but at the same time where the working stresses on the concrete are reduced to less than their real values, is an abuse, and it must be recalled that such an abuse, in the end, means increase of cost or waste.

The foregoing may be termed indirect abuse, inasmuch as the material is capable of doing more for the designer than he will allow or permit; in other words, it is an abuse due to ignorance or lack of confidence.

This brings to mind that a large number of contractors have in mind that a 1:2:4 mixture means 1:6, or that a 1:3:6 mixture means 1:9. Nothing could be more erroneous.

Referring to Taylor & Thompson's "Concrete, Plain and Reinforced," page 232, we find the quantities for material for one cubic yard of concrete based on a barrel of cement of four cubic feet. This table, which is well accepted, gives for a 1:2:4 mixture, using average gravel, 1.44 barrels of cement, while the 1:6 mixture only requires 1.22 barrels. A 1:3:6 mixture, by the same table, requires 1.01 barrels, while the 1:9 mixture only requires 0.75 barrels.

Take either of these cases, there is approximately a difference of a quarter of a barrel of cement, which, at $1.20 per barrel, amounts to 30 cents per cubic yard increased cost for material alone.

Since the same conditions apply to any mixture specified, is it any wonder that on any ordinary size job of two to three thousand yards of concrete, some contractor bids $600 to $1,000 low?

There has been, and is still, considerable discussion as to how many cubic feet shall constitute a barrel of cement, but I believe at this time the majority of opinions favors four cubic feet, or one bag of cement equals one cubic foot. Naturally, if the contents of the barrel are taken as 3.5 cubic feet, the cost per yard of concrete is much increased. This illustrates the necessity of definitely stating in the specifications what shall constitute a barrel. It is an abuse to adopt these lower capacities.

This difference of specifications as to the number of cubic feet in a barrel of cement would amount to a difference of approximately 0.17 barrel per cubic yard of concrete, a difference approximately of 20 cents. This is a direct waste.

The above calculations are based upon average material; if, in addition, a specification is made requiring screened material of a uniform size for a 1:2:4 mixture, on a basis of 3.5 cubic feet of cement per barrel, the amount of cement is again increased by .33 barrel per cubic yard of concrete. Let us make this point clear. Suppose, unthoughtedly, the designer specifies a barrel of cement as 3½ cubic feet and that all material shall be screened and proportioned 1:2:4. In addition, suppose the contractor is not an engineer, and bases his estimate upon what has been his usual practice in the quantity of materials for a yard of concrete. We

have at once one of the peculiarities of concrete construction, and one of the inconsistencies. First, strictly according to the designer's specifications, there are required 1.77 barrels of cement per cubic yard of concrete; the contractor figures on the 1:6 mixture, but overlooks the cubic feet per barrel, and estimates 1.22 barrels of cement per cubic yard of concrete, a difference for material of 66 cents per cubic yard, which, with additional handling and a profit, would certainly amount to not less than 75 cents per cubic yard.

Now, if the use to which the concrete is to be applied does not require so rich a mixture and so strenuous a specification, then the designer is wrong and the contractor is really right in his assumption as to what is really correct, and he may be justified in trying to hoodwink the inspector. On the other hand, granting the purpose for which the concrete is to be used is such that it should be of such proportion and so mixed, then the contractor has underestimated the materials from a cost standpoint. In the first place, the designer causes by the cement specification an extra cost of no real value, but instead a waste, while in the second case the contractor either robs the structure or himself suffers the loss. In either case, not only the owner, but also the community, suffers an economic loss.

Concrete Ties.

As an example of cost data, suppose we assume a few different mixtures or proportions of concrete and work out the cost per cubic yard.

1. Suppose the specifications call for a 1:2:4 mixture to a barrel of cement, to be 3.5 cubic feet, and broken stone screened to uniform size. We estimate as follows:

Stone, .92@$1.50	$1.38
Sand, .46@$1.00	.46
Cement, 1.77@$1.20	2.12
Labor	2.00
Water	.10
Forms, .81@$30.00	2.43
General charges	.54
	$9.03
Profit, 10 per cent	.90
Total cost per cubic yard	$9.93

2. Let us now assume a fair specification for the same work, using a 1:2½:5 mixture, with a barrel taken as 4 cubic feet, and using gravel obtained under usual conditions:

Gravel, .87@$1.00	$ .87
Sand, .44@$1.00	.44
Cement, 1.18@$1.20	1.42
Labor	2.00
Water	.10
Forms, .81@$30.00	2.43
General charges	.54
	$7.80
Profit, 10 per cent	.78
Total cost per cubic yard	$8.58

We have here a difference in bid price of $1.35 per cubic yard, or approximately $4,000 on an ordinary size job.

Suppose the contractor estimates on a basis of past experience, with no particular regard for the exactions of the specifications. We have about the following results:

Gravel and sand, 98@$1.00	$ .98
Cement, .83@$1.20	1.00
Labor	2.00
Water	.10
Forms, .81@$30.00	2.43
General charge	.54
	$7.05
Profit, 10 per cent	.70
Total cost per cubic yard	$7.75

We have here a difference of $2.18 per cubic yard, or $6,500 on the ordinary job. Again, suppose that the contractor simply guesses at the cost on a basis of different character of work—say heavy work, when the cost of forms is low per cubic yard. He will say $5.50 for concrete, assuming the same profit of 10 per cent. The difference then is $13.00. These are conditions which actually exist, and the result is a direct abuse, since after the contract is awarded, he, realizing his error, immediately proceeds by the "first law of nature" and protects his pocketbook at the expense of the work.

We appreciate the fact that all building materials suffer abuse to the extent of substitution of inferior grades or inferior workmanship, but concrete is peculiar in that a very slight change in the wording of the specifications may make a great difference in the grade of work, without same being in any way perceptible to the eye after the forms are removed.

It is now quite a fad to require a time limit, with penalty clause, and in some cases a bonus. Such contracts are an abuse of concrete construction for a great many reasons. Concrete should not be hurried, but carefully mixed and placed. The enforced hurry due to a penalty clause results in many a careless manipulation, sacrificing quality for speed. Night work is uncertain, but is often required. This abuse is by the owner, and is an indication of American business methods, where the immediate dollar outweighs the ultimate value. We constantly build for the present, and our impatient dispositions will not await painstaking work. As concrete work is a permanent construction, or as near as we can obtain same, it is the height of foolishness to sacrifice quality, which will exist for years, for speed, which can only gain a few days.

We have approached this subject from the question of the abuse of this material by the designer. The abuses by the contractor and the contractor's organization are many and various, and are perhaps more vital than the points before mentioned.

It is easy to sit quietly down at a desk, and, after giving proper study of the proposition, formulate a specification as to what materials shall be used and as to how they shall be proportioned. It is also com-

paratively easy for the contractor to arrive at the cost of any specified mixture, at least so far as materials are concerned, but when the contractor attempts the construction of the building, he encounters difficulties innumerable in his attempt to watch materials and men.

If he is experienced he may abuse the material by a leniency which occurs from "familiarity breeds contempt." If not experienced, he may abuse the construction from ignorance. In either case, no matter what his turn of mind, he must employ a large force of men, whose actions and conduct, while nominally under the supervision of the contractor, still are, to a certain extent, dependent upon their own ability and honesty.

Here is a further abuse of the material, which may cover any one or all of the following suggestions:

The quality of the stone, gravel or cement may be an abuse of concrete, regardless of cement and workmanship. Poor material may even cause serious trouble. Walter H. Sawyer, in Engineering Record for November 4, claims the failure of the Austin, Pa., dam was caused by laitance. In the placing of wet concrete different gravels will develop more or less of a tendency in this direction, which is indicated by a slimy, light-gray, muddy substance which rises to the top of the mass and which must be thoroughly cleaned away before new concrete can bond with the old. This "laitance" has little strength, and many times its existence and lack of cleaning have caused criticism of the concrete.

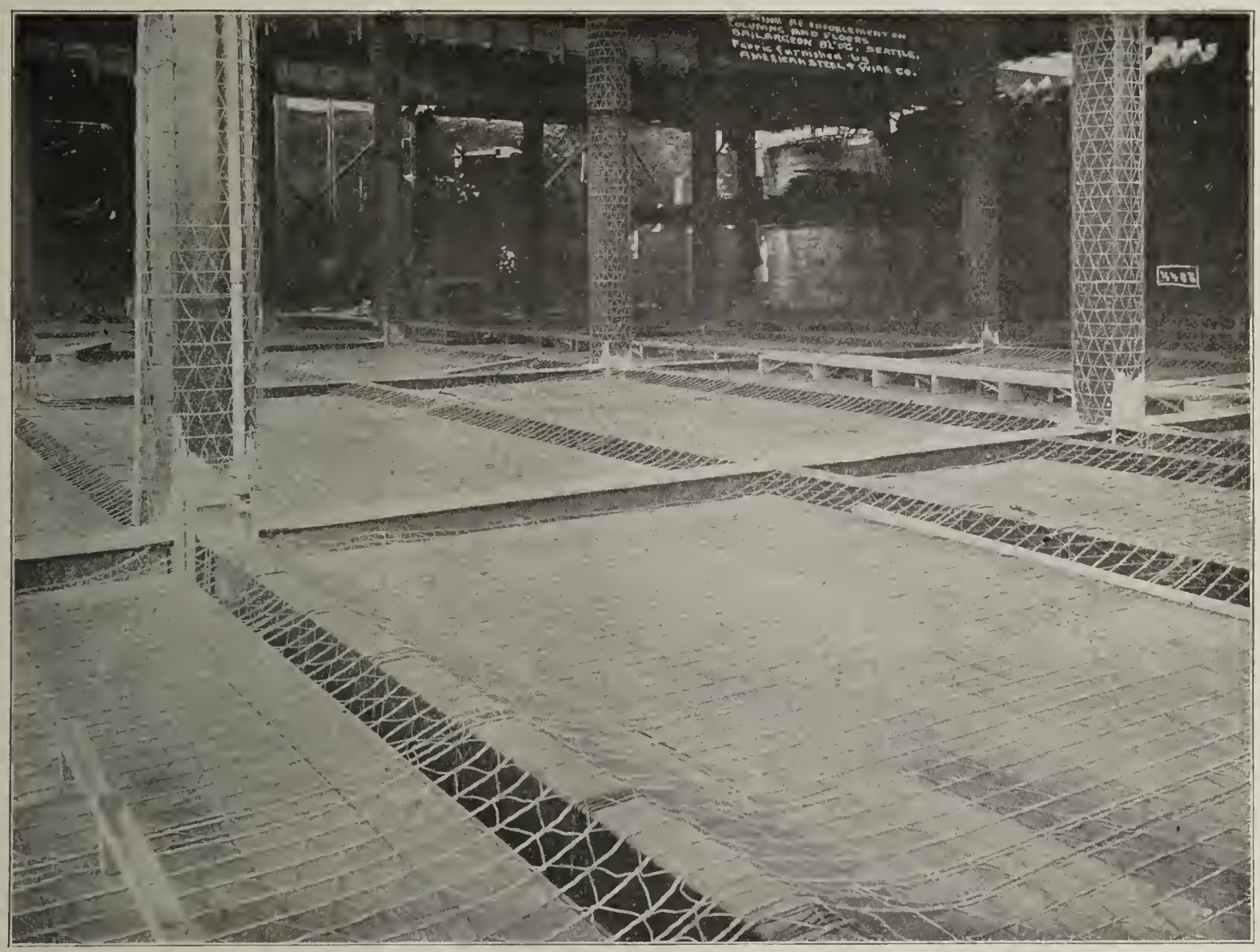
In order to construct of concrete within the limits of commercial competition, it is impossible to await exact and mathematically determined proportions for each batch. In order to compete in cost, concrete must be handled expeditiously, which means by wheelbarrows, carts, buckets etc., loaded by individual laborers in the concrete gang. Some, anxious to please their employer, overload and thereby injure him by their overanxiety to please. Others shirk their work and load as little as possible. In either case speed and cost demand inspection on the run and an estimate by the eye.

Cement being, next to labor, the largest cost, it is often the case that the concrete is abused by a stealing from each batch of a portion of the required amount. This practice is largely the result of experience in the recent past, when most concrete consisted of heavy monolithic work, where the nature of the work was such that no bad results followed such a practice.

These are certainly direct abuses of the materials for concrete.

Modern practice demands wet concrete, and we are more and more using the term "pouring of concrete" rather than the word "placing." Improper pouring of concrete takes into consideration the nature of the work, the amount of work which can be accomplished within working hours, and the design of the structure. There is a general carelessness with reference to this line of thought evidenced by a disposition to simply get the work done and fill up the boxes or forms, without regard for the connection of the various members and their bond together. This is a direct abuse, inasmuch as it affects the strength of the resulting construction.

In order that we may have finished surfaces we can only adopt a method of manipulation designated as "spading." This is a very simple process, and one which can be handled readily by an ordinary laborer, but lack of intelligent instruction or inspection oftentimes leads to defects in the surface after the forms are



PLACING OF REINFORCEMENT ON COLUMNS AND FLOORS ON NEW CONCRETE BUILDING IN SEATTLE, WASH.

removed, which causes criticism where the construction is otherwise good. We too often judge by appearances, but nevertheless this is an abuse of the material, inasmuch as by careful handling there is no occasion for any such results.

While we speak of monolithic work, both in concrete and reinforced concrete, there is really no such thing, inasmuch as we must stop at intervals. The place where these stops are to be made should be planned in advance, and made in an intelligent manner.

In wall work, or work of like character, stops should be made on horizontal and vertical lines, if necessary, with rebate joints to engage the new work. Regardless of instructions or inspection, how many times we find the concrete flowing on an incline down through the forms, leaving an irregular line of demarcation between the old and new work. This is an abuse which is absolutely unnecessary if it were not for the carelessness of the workmen, and affects not only the appearance, but also the strength.

The amount of reinforcement in reinforced concrete work is oftentimes misplaced, due to the disregard or ignorance of the workmen. There seems to be an idea that just so long as the steel reinforcement is covered up or buried in the concrete, all is well. The reinforcement should be placed where indicated by the drawing, and this means that when the concrete is being placed and the steel covered, it should not be violently raised in order that the concrete may flow underneath, for by so doing the reinforcement may be left in a position some little distance above that contemplated by the design. Suppose we have a floor with a reinforcement 6 inches below the top surface. Should this reinforcement be raised carelessly, in order that the concrete may flow under same, we may have a position only 5 inches below the top surface. We have a resulting construction which is only 70 per cent as strong and only a little over 50 per cent as efficient in stiffness. On the other hand, a bar which is entirely exposed cannot be expected to be bonded with the concrete.

Modern design in nearly every case, for structures of any importance, contemplates the use of top reinforcement, or, speaking more technically, reverse flexure bars, over the points of support. If the question of placing of the main reinforcement is important, the subject of this top reinforcement is often more important. Improper placing of these bars may result in 50 per cent. reduction in the safety factor.

It is a very common construction to introduce a cement finish for a wearing surface on floors of plain concrete, on the ground floor, and on reinforced concrete floors. To say nothing of the care in the preparation of this mixture and the manner in which same is handled, we have a problem on our hands to place this finish in a proper manner. In the first place, the cement finish is not considered a part of the structural concrete.

If it is placed at the same time as the mixture used for the structural portion, it must also be wet, which introduces an element of uncertainty as to the satisfactory results obtained by the cement finishers. On the other hand, if it is placed at a subsequent period, after the structural concrete has hardened, we are uncertain in our results as to the bonding of the new with the old work. Carelessness in cleaning surfaces is so common that the material is abused by this lack of attention to detail.

We have no material which will better serve the purpose of exterior finish, if properly handled. It is a mistake to mask a concrete structure by using a facing of brick, stone or terra cotta, but the designer and the contractor must be educated to the viewpoint that perfectly finished surfaces cannot be obtained at the price of ordinary concrete work, and yet can be obtained at a much less cost than for the facing of other material. The cheap jobs we ordinarily observe are not due to defects in the material, but to prices which are too low and to workmen not sufficiently adept in this line of work.

This abuse of cement construction should be corrected, and can be by the harmonious co-operation given by your organization. This subject is deserving of a special, prominent treatment in your specifications, instead of being oftentimes an obscure item. The contractor should not be censured for results which are obtained under cheap competition and rush work.

The forms and centers for concrete work, under ordinary conditions, are left entirely to the contractor. It is a question whether same should not form a part of the architect's drawings and specifications, in order that all contractors should figure alike as to requirements. The requirements of tongue and groove lumber, etc., add to the cost, without in any sense adding to the durability of the work. There is a wide variation in the present specifications for forms, but throughout there is a general vagueness and uncertainty which leaves the contractor to design his own work. The result is, some forms are constructed intelligently and others far from it. Inasmuch as this cost, under ordinary circumstances, will run from 25 to 33 per cent of the entire cost of the work, it would seem that the subject is deserving of a more intelligent study and determination.

In a general way, from a contractor's standpoint, there is no class of construction where carelessness, accumulation of dirt, rubbish, etc., are more detrimental than in concrete. The material is continually abused by a lack of respect on the part of the workmen from the time the raw material is in the piles until it is in the finished work. It is a continual fight to exclude improper material, rubbish and offal.

If it were not for the safety that exists in concrete construction, in addition to the factor allowed, many points of weakness would develop which at the present time are concealed within the mass.

FOREIGN SHIPMENTS OF MEDUSA WHITE CEMENT.

The Sandusky Portland Cement company has just shipped 5 cars of Medusa White Portland Cement to Sydney, Australia, and 2 cars to Delagoa Bay, South Africa. Several thousand barrels will also be used on the Woolworth building, New York, the highest office building in the world.

CAPACITY OF SAND-LIME BRICK PLANT DOUBLED.

The Spokane Pressed Brick Company will double the capacity of its sand-lime plant at Mead, Washington, during the winter, and in the spring expects to be in shape to turn out 50,000 brick a day. The company has increased its capital stock from $150,000 to $200,000, in order to care for the purchase of new machinery, including a new brick press.

White Sand

White sand of various kinds and descriptions is found in numerous places throughout the United States, but the sand that is found in Illinois is acknowledged as the best produced. Illinois sands differ materially in their color, coarseness and chemical purity. In most places coarse Silica sand is usually off color, caused by the amount of iron or magnesia they contain. In other places a pure white Silica is found, and while it is of good quality, it is too fine for most purposes. Ottawa, Illinois, is the only place now known where a chemically pure, white, coarse, Silica sand is found. For that reason, engineers, architects and consumers requiring the best material specify this sand.

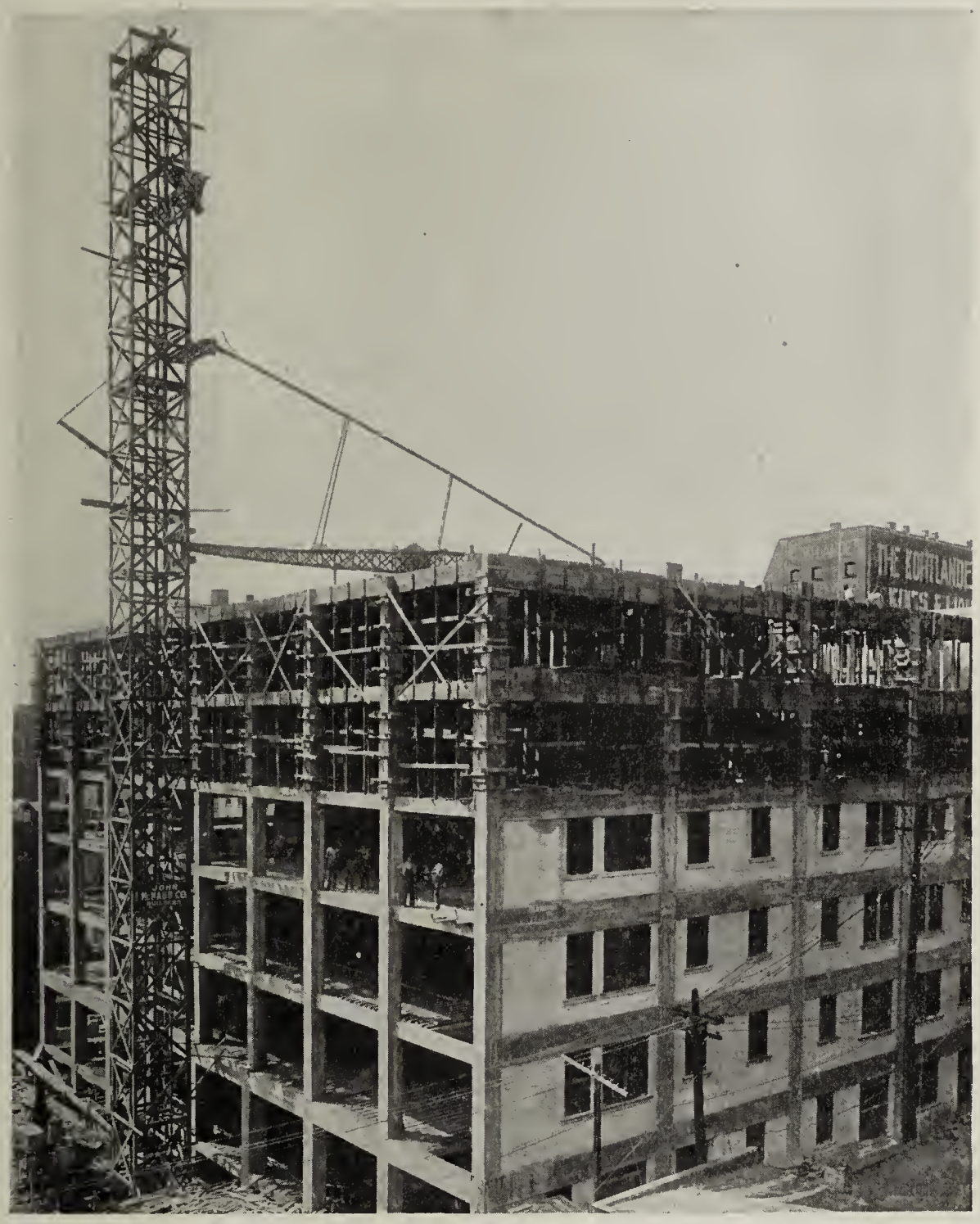
The United States Silica Co. operates the largest Silica Sand Plant in the United States, at Ottawa, Illinois, and give special attention to the production of different grades of Silica sand that answer best the purposes for which they are to be used.

For cement plaster and facing work, they produce a special Silica, sold under their trade name of Crystal Silica. This material is thoroughly washed, screened and dried. It is undoubtedly the best white sand produced in the United States for this class of work.

It is not their intention to encourage the use of this high class sand in the ordinary rough concrete work, but in those structures where appearances are considered, white sand should be used, at least, for the facing, for every one knows that there is absolutely nothing attractive about the appearance of the ordinary concrete structure. The design may be beautiful, but the dark bluish gray color in most cases ruins the effect. White sand should be used in these structures, for the same reason that attractive paint is used to decorate the interior or exterior of your home or office. The cost is very little, the effect is beautiful, and ever lasting.

Crystal Silica is pure. Changes of temperature cannot effect its color or durability. Crystal Silica is white sand, but white sand is not Crystal Silica.

Engineers' reports show that the strength of concrete depends to a large extent upon the proper grading of the aggregates, and while some sand may be uniformly coarse, others uniformly fine they cannot be used without weakening the concrete, increasing its porosity and the liability of checking when exposed to atmospheric conditions. Crystal Silica is properly graded from twenty to one hundred mesh, the voids made by the larger grains are filled by the smaller.



SIX-STORY STORE AND WAREHOUSE BUILDING, GRAND RAPIDS.
Reinforced Concrete Skeleton Frame—Corl-Knott Building.

Wm. A. Radford, an authority on concrete constructions, says, in his book "Cement, and How to Use it," regarding the selection of aggregates: "In the first place an aggregate for any kind of work should be clean. Dirt is a sign of weakness. Any foreign substance, such as mud or clay, forming a coating on the particles of the aggregate, prevents the cement from coming into contact with the surface, and lowers the cohesive strength of the concrete, or its power to hold itself together. It may also seriously retard the setting. A loss of fifteen to twenty per cent in strength may be caused by the use of a dirty aggregate."

Tests made by G. F. Gebhardt, M. E. of the University of Chicago showing comparative crushing strength of Crystal Silica and coarse torpedo sand by using one part cement, two parts Crystal Silica and four parts crushed lime stone in twenty-eight day blocks, shows the Crystal Silica block has a strength of two thousand and eighty-five pounds to the square inch, as compared with two thousand one hundred and ten pounds of the torpedo sand block, the results of these tests are here given to prove that Crystal Silica can be successfully used in the place of torpedo sand without weakening the strength of concrete to an appreciable extent.

Maximum strength is not the result required in surfacing or facing. Porosity and checking are the dangers to be avoided.

The most important thing to be considered after the design of a concrete structure is made, is the character of the surface, for when viewed at a close range, the surface finish may take precedence over proportion.

When a cement finish is desired on a concrete wall, it is best that the finish be from one to three inches thick and placed while the wall is being built. A finish put on after the wall is built will usually crack and give poor results.

When it is necessary to put a cement finish on a constructed wall, care should be taken to prepare the surface in order to make the cement stick. A good method is to pick the wall to make a rough surface. A rich mortar containing one part of cement and two parts of sand, should be used. Lime paste may be added as it will increase the adhesion and lessens the liability to crack. This may, however, cause efflorescence, a white crust on the surface, unless thoroughly washed with a dilute solution of commercial hydrochloric acid, one part of acid, to ten parts of water.

Another good method is to thoroughly wash the wall, and while wet, brush on a coat of neat cement. While this is wet put on a coat of plaster about three-quarters of an inch thick, following by succeeding coats of equal thickness about an hour apart until the desired thickness is secured.

Facing during construction should be from one to one and one-half inches thick, and may be applied to the forms just ahead of the backing which is placed against, and rammed into it, or the backing may be placed first and pushed back from the form with a spade, and the facing material deposited between the backing and the form.

Granolithic Plates.

Probably the best method for facing concrete is by using what may be called metal facing forms, constructed and used as follows: Rivet three one or one and one-half inch angles to a six-foot length of three-sixteenth inch iron plate, eight or ten inches wide, placing an angle at the center and one about six inches from each end. Slightly flare one edge of the plate to aid depositing of the material. Provide this edge with handles. The metal facing plate is placed against the wall formed with handles up, and the angles tight against the form. The space between it and the back of the wall, fill with concrete backing, and the one or one and one-half inch space between the metal form and the face form, fill with the facing material. The metal form is almost drawn out, and after thoroughly packing the backing against the facing, the process is repeated.

Brushing and Etching.

For brushed surfaces, the forms must be removed from the work as soon as possible, and the concrete surface brushed while still green. It is not possible to state how old the work should be before removing the forms and brushing the surface. This will depend upon a number of conditions—the character of the work, the cement and aggregate used, the consistency of the mixture, and very much upon the weather conditions. As a rule, in hot weather the forms can be removed the next day and the surface brushed; but in cold weather the facing form cannot be removed so soon, several days or perhaps a week being required for the concrete to attain the necessary hardness and strength.

Care must be taken that the brushing is not done too soon, as little particles of aggregate will be removed, resulting in a pitted, unsightly surface. On the other hand, the longer the surface stands before being brushed the more brushing it will require to remove the film of material that has flushed to the surface. Brushing should be done just as soon as it can be without removing particles of aggregate. When this can be done, can be determined only by experimenting with the particular surface. An ordinary scrubbing brush with stiff palmetto fibres, or a metal wire brush, will answer for the work.

Two or three days after the brushing, the surface should be washed down with a dilute solution of commercial hydrochloric acid, one part acid, to two parts water. The acid should be applied with an ordinary calcimining brush, and the walls thoroughly rubbed while wet with the acid, with a stiff vegetable fibre brush. The acid should not be allowed to remain on the surface for any length of time—not over half an hour—and should be washed off with a hose and clean water. It is important that the surface should be thoroughly washed after the acid treatment, for if it is not, it will have mottled, streaky appearance.

This method of treatment removes the film of mortar that has flushed to the surface, exposes the aggregate, erases all traces of form markings, and produces a rougher, more artistic surface.

Facing Concrete Blocks.

There are two general types into which concrete block machines are classified—namely, vertical-faced machines, and face-down or horizontal-faced machines. These names indicate the position occupied by the face of the block during the moulding process. In the "face-down" or "down-face" machines, the face-plate forms the bottom of the mould; in the other type, this plate is held in a vertical position. The face-down machine is the more easily adapted to applying specially treated faces to blocks. If a vertical machine is used, the special facing (consisting simply of rich mortar, which may be colored, waterproofed, etc.) is placed while the mixture forming the body of the block is kept back by a parting plate or other device. In the face-down machine, the facing can be placed directly in the bottom of the mould and the coarser body mixture be placed above it.

PATENT GRANTED ON NEW CONCRETE METHOD.

Metallic Powder Mixed with Cement Does Away with All Flooring Difficulties.

The Patent Office Gazette, of December 26th, No. 1,012,832, contains an article of unusual interest and value to engineers, contractors and all others either directly or indirectly connected with concrete construction and use. Particularly is it of interest in connection with floor work.

Information is given of the fact that there has been patented a process by which a cement floor or structure may be resurfaced, the new surface being bonded perfectly to the original structure, the same being accomplished by the use of a coating made up in part of a finely ground metallic powder. The process, which is known as the master builders' method, from the name of the company which controls it, is an invention not only of great scientific moment, but of practical every day value. It is destined, according to cement experts, to be universally utilized, for it is the one method yet discovered by which old floors may be successfully patched, or new floors laid wear proof, dustproof and waterproof.

The difficulty with concrete floors has always been great; where much weight constantly passes over them, they have worn down in places, leaving holes and ruts. This has been because of the porosity of the concrete—its lack of proper solidity. At the same time the floors give off dust which, settling in machinery and making friction, has brought delay and loss to factories. Moreover cemented floors have lacked the quality of being waterproof, and drinking in liquids almost like sponges, they have soon become soggy and hilly.

By the master builders' method, the Gazette goes on to state, these difficulties are entirely obviated, it now being possible to make floors that are practically indestructible. In the many factories, breweries, laboratories, warehouses, etc., where it has already been adopted, it has been styled a method of "armor-plating" a floor.

The patent was granted the master builders' method for various reasons. It was immediately shown to be entirely original, and alone in the field. It was shown that it is admirably adapted, not only for original coverings, but for patching. It is in patching holes in old floors that the value of the bonding function is emphasized.

Likewise will the method be of great utility to the manufacturer who wishes to plaster the inside of a concrete vat or cistern, or a concrete wall, for he now has a sure method of creating a perfect bond between the plaster coat and the old surface.

Master builders' concrete filler is unique in its simplicity. It is composed primarily of a metal powder of cement fineness. This is added to the concrete when mixing. Then under the influence of moisture while the concrete is "setting," the filler expands through oxidation of the metal, filling up all the voids and air holes, and making a cement body that is practically solid. By greatly increasing the density of concrete in this manner, the method makes the floor of almost impenetrable hardness.

The method of adding the filler to the cement may be employed at all times, whether for laying new floor surface or for filling in holes in connection with the above described process for patch work. In the latter event, it is claimed, it will be found that the patch is much harder and more durable than the old surrounding concrete, if the latter has been laid by the old-fashioned method—that is, without filler.

It is particularly gratifying to note that the master builders' method does not involve any fundamental change in the usual manner of laying concrete floors, nor does it involve any added labor expense. This fact, coupled with the great inherent merit of the system, will make the new method doubly welcome to every plant owner who can profit by having concrete floors wearproof, waterproof, dustproof and acidproof.

MASON CITY, IOWA, PLANT, LEHIGH PORTLAND CEMENT CO.
Capacity, 6,000 Barrels Daily.

The Construction of a Cement Mill.

The Lehigh Portland Cement Co. has just completed a new plant at Mason City, Iowa. The site selected for the mill buildings comprises 40 acres of rich, level prairie land, lying west of and adjacent to the main line of the Chicago Great Western Railroad, and inclining slightly to the southwest in the direction of Calamus Creek which traverses the property and forms the western boundary of the plant site, offering drainage facilities and an adequate supply of water for steam purposes and fire protection.

The limestone quarry was opened on the same property and all crushed stone used in the construction work was quarried there. Extensive deposits of clay are also available on the property.

PACK AND STOCK HOUSE, ENGINES AND ELECTRICAL MACHINERY BEING UNLOADED IN FOREGROUND.

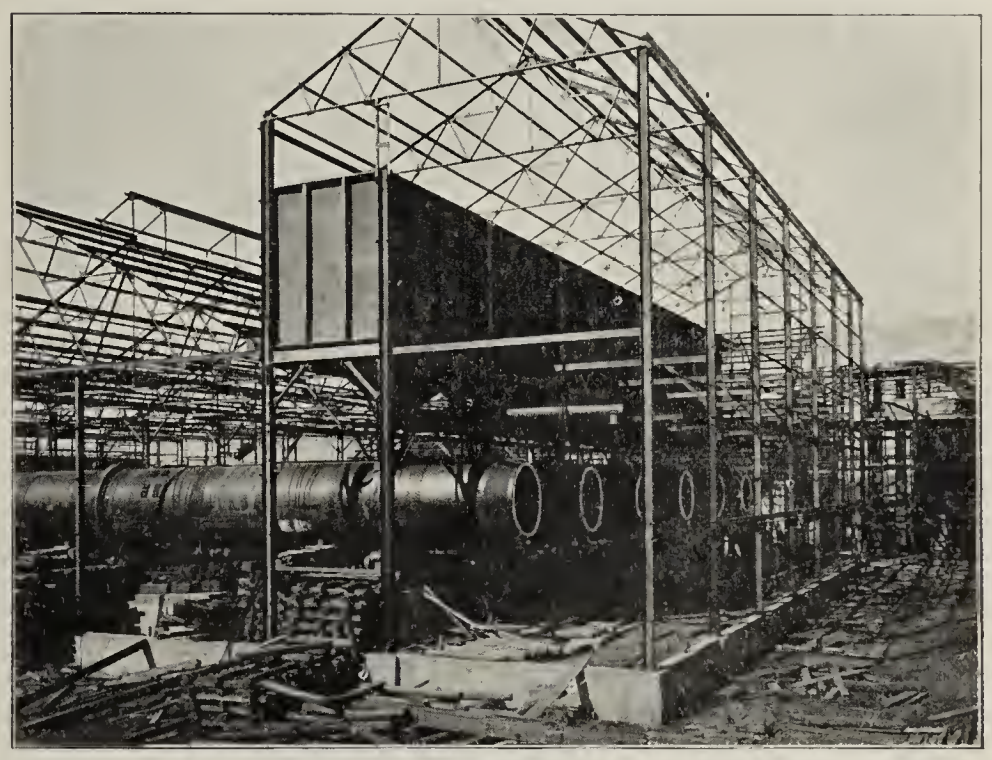
The general type of construction which has been followed on all principal mill buildings is fireproof or slow-burning, consisting of monolithic concrete walls on massive foundations, heavy steel columns, girders and roof trusses, steel storage bins, iron runways and heavy plate conveyor troughs. The roofing and sid-

CLAY DRYER AND STORAGE BUILDINGS,
Showing Clay Dryers and Trestle, also Belt Runway from Clay Dryers to Clay Storage.

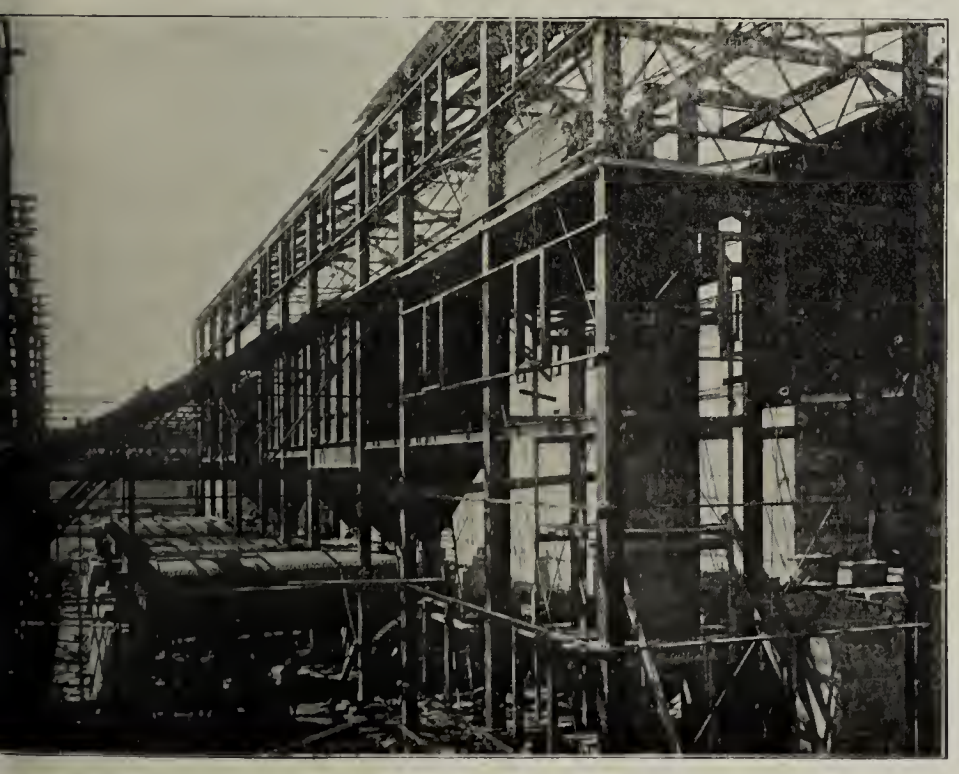
Clay and Stone Dryers in Position—Boiler House May Be Seen at Left Through Steel Work.

Kiln Building, Front View, Showing Kilns in Position, Also Raw Mill with Tubes and Kominuters with Bins Overhead, and End of Coal House.

Clinker and Finishing Mill, Showing Bins in Place and Concrete Chimney About Half Completed, Also Steel Bridge from Clinker Mill to Stock House.



Kiln Building, Rear View, Showing Rotary Kilns in Place with Steel Storage Bins for Raw Stock Overhead.



Raw Mill Showing Five Tube Mills on Foundations and Bins Over Tube Elevators.

Dryer Building, Showing Rear, Middle and Front Sections and Dryers—Also Raw Mill with One Kominuter in Place and Two in the Foreground.

ing, where concrete is not used, consists of heavy corrugated galvanized sheets. The floors throughout all the buildings are of concrete.

The established policy of the Lehigh Company of employing a type of construction which experience has proven to be the best adapted to withstand the stress and strain incident to the installation of the heavier class of modern mill machinery, which consists of larger units in all departments with proportionate increase in driving power, was applied in designing and constructing the Mason City plant.

The limestone quarry and clay deposits are both close to the plant. The stone crushing plant has a capacity of 2,000 tons of rock per day, and the crushers will receive a stone up to 36 in. in diameter and reduce down to 2 in. or 2½ in. in size.

The storage building at Mason City, 992 ft. long, is sufficiently large to store enough limestone and clay to make about 1,000,000 bbls. of cement. The limestone after it has been crushed is discharged in a 24-in. conveying belt to this storage building, as is also the clay after it has passed through the disintegrators and the dryers. In this way an ample supply of limestone and clay can be had at all times in case of interference in the daily output on account of unfavorable weather.

The kiln building contains a battery of six rotary kilns mounted on heavy type roller bearings, driven by variable speed motors operating in connection with the variable coal feeders, admitting of a regulation of kiln speed and feed within all the desired limits to insure a maximum of kiln production consistent with thorough clinkering and proper calcimining of the raw material.

With ample storage and good railroad connections, this new plant will prove a valuable link in the chain of Lehigh plants.

REINFORCED CONCRETE DEMANDS SPECIALISTS.

The collapsing of a reinforced concrete building in Indianapolis on December 6, killing eight men and injuring twenty-one others, has again brought forward for discussion the cause of failures in construction of reinforced concrete, says "Building Progress."

At the outset we can accept as a premise that it is inexperience and lack of intelligent supervision which is the most prolific cause of failure. This will be better understood by considering the following possibilities of failure from faulty design and faulty construction. Taking up first the possibility of failure from faulty design, it can be broadly stated that there is less danger from this source than from faulty construction. There is nothing problematic about the strength of good concrete, or good concrete reinforced with steel, any more than there is about the strength of bricks or stone. The only trouble is, that in designing the architect must assume that the work will be well done, and the reinforcing properly placed, and this only good, intelligent supervision will accomplish. If the work is improperly done, or poor materials lacking in strength are used, either through ignorance or carelessness, the designer's calculations will be brought to nought, just the same as if sun-dried bricks were used instead of granite or wooden beams were substituted for steel girders.

Assuming that the materials used will be good, knowing their strength and allowing the usual factors of safety common to architectural and engineering design, there is nothing about the planning of an ordinary building which would overtax the ability of a good reinforced concrete engineer. Even if an error did creep into his calculations, the checking and rechecking which work of this character receives would

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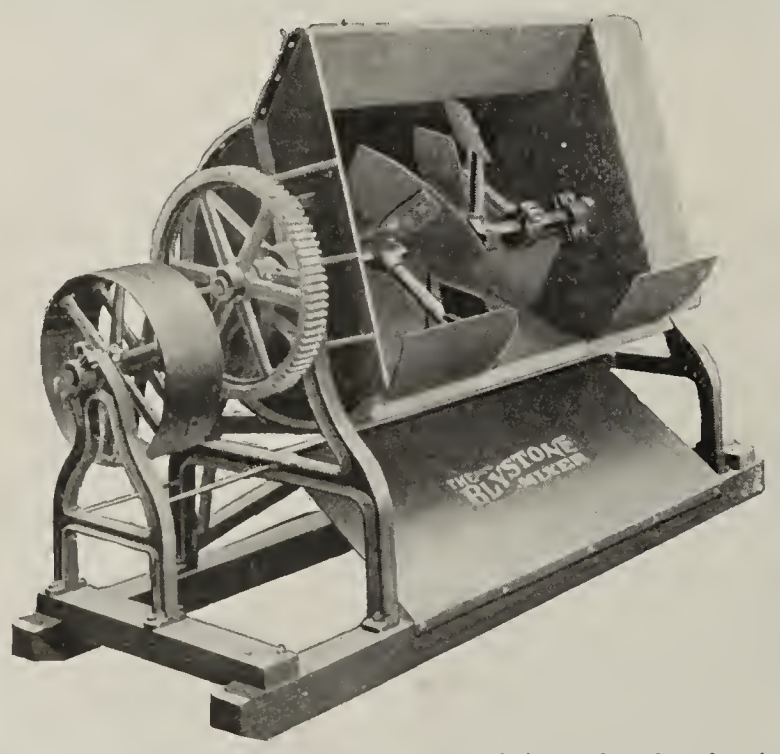

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reveal the defective design, if, indeed, good judgment would not detect the false proportions from previous experience with the same class of work. We may dismiss as improbable, then, the likelihood of faulty design being the cause of reinforced concrete buildings collapsing.

It is in the construction end of the building, then, where the greatest responsibility lies, and where the greatest care, the utmost experience, the constant vigilance and skilled supervision are needed. Indeed, the very weakness which makes reinforced concrete an unknown quantity is the fact that one poor batch of concrete, or the misplacing of the reinforcing materials might write disaster in the history of the structure. Unfortunately, the impression has gone abroad that it requires only unskilled labor to erect a reinforced concrete building. Unfortunately, for that is not true; it is only partly true.

It is quite true that ordinary laborers are used in concrete work, while in a brick building high-priced bricklayers would be required. But the real difference comes in when the personnel of the superintendents is considered. The man in charge of a bricklayer crew owes his position to his success in getting work out of his men. That is all that is required of him, for the materials are of such a nature that all they require is careful laying to develop their entire strength. Such a foreman would be absolutely worthless in charge of reinforced concrete work; worse than that, he would be absolutely dangerous, for his "hurry-up" methods are not conducive to the best of results, and, unfortunately, when reinforced concrete work is given to the ordinary contractor that is the kind of man usually in charge.

The superintendent in charge of reinforced concrete construction must be more than a labor driver. He must be first and foremost, a trained engineer who understands not only cement, concrete, steel, and the combination of the three, but likewise possesses a good knowledge of building in general, and has an intimate and first-hand knowledge of the strength of beams, the loads walls, floors and columns will carry, and has a keen perception and broad judgment to guide him in his work.

In short, reinforced concrete work is not common laborers' work, and the sooner that truth is realized the sooner will failures in this class of buildings cease. On the contrary, reinforced concrete work is a highly specialized form of building, and requires more than the ordinary supervision to carry it successfully through. Instead of giving such work to the ordinary contractor it should be given to specialists, and specialists only, for there are specialists in reinforced concrete construction. That is the point to remember, for in this form of construction more than in any other kind of a building is where a specialist is needed. We know this perfectly, for that is part of our line, and we have made it a point to select our superintendents with particular reference to their fitness, then train and further educate them for the work in hand.

Where the great mistake is made in the erecting of buildings of reinforced concrete is in giving the work to an ordinary mason contractor, believing he can do the work satisfactorily because it is mason's materials that are to be used. What the architects seem not to have grasped heretofore is that reinforced concrete work is engineering work, not mason work; that an engineer, not a workman, must have charge of the work if it is to be properly done, for the design and construction go hand in hand. The placing of the

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reinforcing rods in the walls, floors, columns and beams in even the best work is left to the superintendent to see carried out properly.

In the erecting of steel framework for buildings the beams are all cut and punched at the shops, under direction of the structural engineer, or in accordance with plans prepared by him, and erected according to other drawings. In such a case every beam must be used in that place or it will not fit. Nothing is left to the judgment of the workmen on the building. That is the exact method of building. In the case of reinforced concrete nothing can or will be in the exact place unless it is placed there under the careful supervision of an engineer who understands the need of being exact.

There will be fewer reinforced concrete failures in the future if architects will just keep that fact in mind. The success or failure of their plans and reputations depends more on the people entrusted with their work than in any other method of construction. To entrust the work to ordinary contractors, under the mistaken impression that concrete building is rough work anybody can do, is to invite failure, and failure means failure in a double sense to the architect who designs a building that collapses.

At Hamburg there are two bridges, the masonry of which was threatening to fall in ruins, being traversed by innumerable cracks of varying size. A remarkable process has just been made use of to rejuvenate these bridges. A number of holes were bored throughout the structure so as to give access to the interior and cement was injected by pumps under pressure. Reports on the present condition of the two bridges are favorable.

HAND-POWER BENDER FOR LARGE REINFORCING BARS.

A very powerful machine for bending reinforcing rods cold, operated by one man, has recently been brought out by the Wallace Supply Co., 123 N. Jefferson St., Chicago.

The machine is designed particularly to handle heavy stock and will bend 1¼ in. bars cold without any difficulty. Rounds and flats can also be bent on this machine, and by substituting higher dies flat stock of 4 in. width or even wider can be handled successfully. The jaws or dies of the machine are so arranged that they can be easily set to suit various sizes of bars.

The power is obtained by a lever which is operated by a ratchet in combination with a small pinion which engages a series of cogs on the edge of the main frame of the machine, the gearing being on a ratio of about 8 to 1.

This machine will be known as the No. 5 angle bender and is the outgrowth of long experience in the manufacture of bending tools of all kinds. The machine may be purchased complete with or without a cast iron stand.

The approximate weight of the No. 5 angle bender is 268 lb. without stand. The stand weighs about 160 lbs. A complete catalogue of ring benders, eye benders and angle benders will be sent upon application to the Wallace Supply Co., by mentioning Cement & Engineering News.

ANOTHER SAND-LIME BRICK PLANT FOR CANADA.

Leitner, Euwecke & Peters, Winnipeg, Canada, manufactureres of sand lime bricks, plan to build a brick plant, capacity 48,000 per day; clay brick will also be made

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HAND BOOK ON BRICK AND BLOCK.

C. J. Helm has written a book on concrete block and brick making. Ordinarily Mr. Helm is engaged in the manufacture of concrete machinery, but he has had a lot of experience in the concrete business, the practical end of it, and he decided to put his ideas into type.

"A Hand Book of Concrete Brick and Block Making" is the title of the book, which contains a vast amount of valuable information of special interest to brick and block manufacturers and others who contemplate entering the business. The book is published by the Queen City Brick Machine Co., Traverse City, Mich., and is sent without charge to interested inquirers, by mentioning Cement and Engineering News.

The main portion of the text is devoted to the following sixteen subjects: The field for concrete, selection of materials, how to proportion, how to cure product, plant arrangement, how to estimate, comparative tests, table of compression working values, ways of making products, various building systems, forming the product, steam curing, a waterproof building, system fully illustrated, weights of materials, hints on selling, profits in concrete.

While of course the matter is written with special reference to the particular brick and block made on the company's machines, most of the information is general in its character and is much more reliable than some of that contained in cloth-bound books published in the past by authors who wrote books as a means of livelihood.

It is seldom that a piece of business literature contains so great a fund of general information and we know our readers will welcome this notice of a valuable hand book.

The Queen City Brick Machine Co. manufactures mechanical presses which turn out concrete brick or concrete block for two-piece wall construction. The material is mixed quite wet and subjected to 80,000 pounds pressure. Buildings erected of these products are seldom furred and lathed, interior plaster being applied direct to the walls. The company publishes a machinery catalog listing its presses, which must not be confused with the hand book mentioned above.

The Dakota Portland Cement Co. has decided to remove its offices from Sioux Falls, S. D., to Chamberlain, where the plant is located. It is thought that the location of the offices of the company at the site of the plant will greatly facilitate the handling of the company's business. A salesroom will be opened in Minneapolis. D. B. Zimmer, vice president of the company, will continue to reside in Sioux Falls.

REINFORCING BARS.

A change in the building code in Cleveland, Ohio, has been agreed to which will permit the use of hard steel bars in concrete reinforcing work in that city. Complaint was recently made by the Franklin Steel Company that the test requirements under the present code were impossible to meet with hard steel bars made from rerolled rails. The amendment to the code will provide that the physical tests for hard steel bars shall be the same as for soft steel. One test is to be made in an approved laboratory for each 10-ton lot of bars. The bars are to be hot twisted, instead of cold twisted as required for soft steel bars, and are to be twisted with one complete twist in a length equal to not more than 12 times the thickness of the bar.

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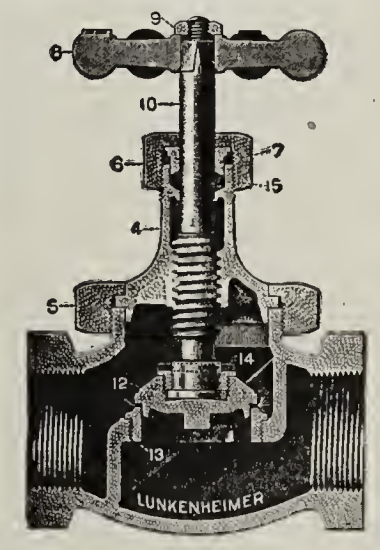

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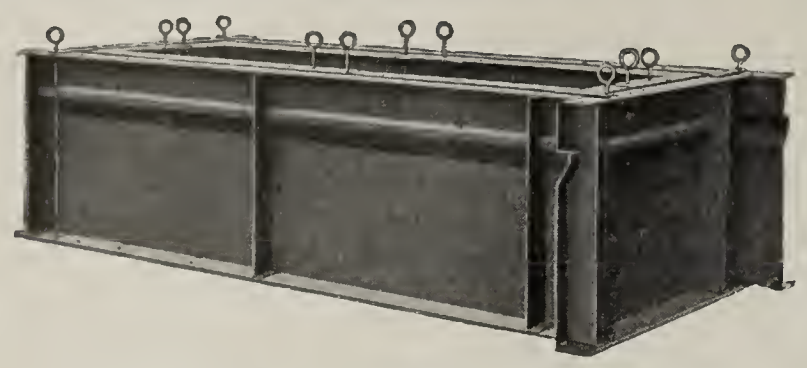

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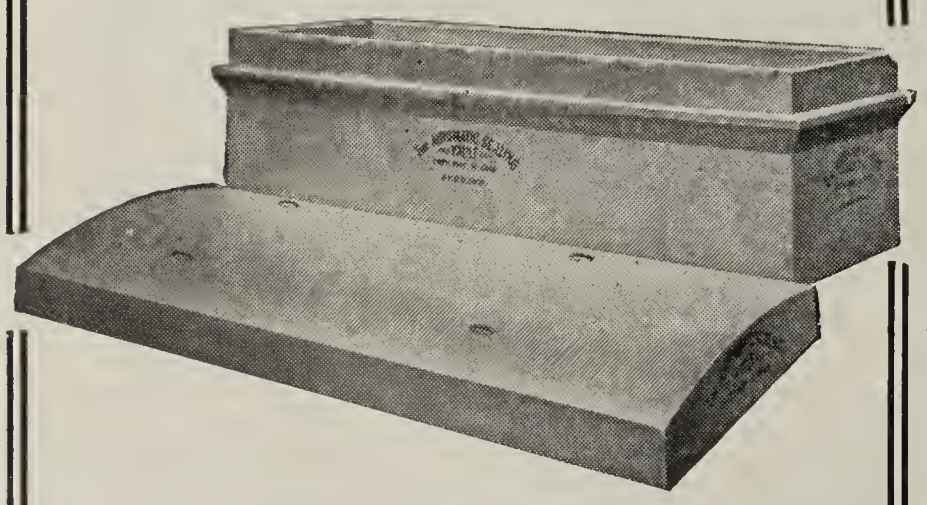

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CHICAGO, MARCH, 1912

TESTS OF CONCRETE DURING CONSTRUCTION.

Continuous testing of concrete in the course of construction of a building, which has been frequently recommended by us to the American contractor, but up to this time in vain, has been considered necessary for some time by European builders.

All we expected the contractor to do was to accompany his work by comparative tests of six-inch concrete cubes made of identically the same concrete that went into the construction work and hardened on the premises under identically the same weather conditions. These tests would tell, whether or not the concrete had gained enough strength to safely remove the forms at the contemplated time.

The forms and the additional work required for making these tests amount to very little and must be considered a mere bagatelle if compared with the safety afforded to the men engaged in the work of removing the forms. But, in spite of this, none of the American building codes has so far included similar tests in its rules and only very few contractors resort to safe methods of testing the concrete during construction.

Test Cubes and Test Beams Made in the Course of Construction of the War Department Building at Vienna, Austria.

In the face of the reckless way of erecting concrete structures in this country, which leads to a number of serious accidents every season, it is a relief to read about the cautious methods pursued by European engineers.

In the construction of the war department building at Vienna, for instance, not only concrete cubes were made, but entire beams as shown on the accompanying cut.

These tests brought out the fact that concrete work must be discontinued in cold weather by all means, hence that it is a mistake to believe that concrete is not permanently injured by frost and that previous heating of the materials saves the concrete from subsequent injury. Even mild winter weather resulted in changes within the concrete which could never be remedied in the future.

This deduction, drawn at first from the low strength of the test cubes and test beams of comparatively small dimensions and from a minute investigation of the physical structure of the hardened concrete of these test pieces, had to be upheld after a careful subsequent examination of the concrete forming part of the actual construction work. Even members of the largest proportions had to be considered permanently injured by mild frost, notwithstanding all possible precautions taken to keep the concrete covered.

As a consequence, all building was discontinued for three months and the forms of work done in the fall were left in place until spring, when the test beams and cubes showed that the concrete had obtained at least a safe proportion of the strength expected at that time.

The concrete and steel used for the test specimens amounted to one-twentieth of a per cent of the total material used in the construction. The expense in materials and labor, therefore, was regarded insignificant and, compared to the valuable information obtained by the tests, was judged to be indispensable in all similar construction work.

DECISION IN FAVOR OF TUFA CEMENT.

Mayor Alexander sent the council yesterday a message vetoing the ordinance passed recently governing the testing of cement in construction in Los Angeles.

The mayor said he believes the ordinance tends toward monopoly and suggests it might be well to amend it to permit new brands of cement which satisfactorily pass all the tests, including the 28-day test to be used in concrete construction, even if it has not been used for other purposes for one year.

"It may not be necessary to compel builders in all instances to make the tests required by subdivision 15, but I believe it should be within the power of the Board of Public Works to require such tests," he said. "The first sentence of Section 176 reads: 'Only Portland cement shall be permitted in reinforced or non-reinforced concrete construction.' It has been demonstrated that the tufa cement used in the construction of the aqueduct is as strong as Portland cement. I would recommend that any cement may be used in concrete construction that will stand the tests required by the American Society for Testing Materials."

Concrete in San Francisco and Vicinity

By John B. Leonard

In order to properly appreciate the use of reinforced concrete in San Francisco and vicinity at the present time, it is essential to understand the conditions existing in this territory immediately previous to the great earthquake of San Francisco in 1906. By vicinity, the writer refers to that portion of California that is within the radius of 150 miles of San Francisco.

Prior to April 18, 1906, the building laws of the city of San Francisco were so framed that they did not permit the construction of an all reinforced concrete building. They did allow the use of reinforced concrete for foundation work, sidewalk walls and floor slabs. Architects were also allowed the use of reinforced concrete, intermediate beams in a structural steel frame, and this device had been resorted to in two or three instances. There were many buildings in which reinforced concrete floor slabs were used, and also concrete fireproofing for the columns, but a large portion of the practice used tile for floor and fireproofing purposes.

The advocates of reinforced concrete, however, were making a very strenuous fight to secure permission to construct of this material, and their efforts would undoubtedly have secured favorable results in a short time.

San Francisco being the metropolis, so then, as it is today, was the guide for the smaller interior cities and villages in all essential matters pertaining to building construction.

The Effect of Earthquake on Reinforced Concrete Buildings.—Owing to the building laws of San Francisco denying the privilege of constructing reinforced concrete buildings in the city limits there were no completed building of this type in San Francisco at the time of the earthquake and fire. There was one building just being constructed. The owner had never received an official permit for the erection of this building, but being confident of the merits of reinforced concrete, intended to abide by the issue in the courts. This structure was intended for storage purposes, and was to be six stories high. The foundation, columns, girders, floor and roof slabs were to be of reinforced concrete, and the enclosing walls of brick. At the time of our great disaster the second floor had been completed and forms were up for the third floor, also the curtain walls were up nearly to the third floor.

The building was not subjected to any intense fire, but it was in a section of the city that suffered severely from the earthquake. An examination of the building a few days after the disaster showed that the brick curtain walls had suffered considerably, but that the reinforced concrete portion of the structure was entirely sound. The fault in the curtain walls has since been corrected and the building carried on to completion in reinforced concrete.

At the Leland Stanford, Jr., University, located at Palo Alto, about thirty miles south of San Francisco, in the Santa Clara Valley, and but a few miles from the famous fault line, there existed a reinforced concrete building that was constructed some twenty-three years ago. This building, known as the Museum building, had a length of about 300 feet and a depth of about 50 feet, and is two stories high. The construction was entirely of reinforced concrete, consisting of interior columns, girders, beams and floors and enclosed with concrete bearing walls. The enclosure walls, however, were not reinforced except at the floor levels, the space between the floor levels consisting of plain concrete.

Shortly after the completion of the building, as was to be expected, shrinkage cracks appeared in some of the walls. Recent observers have mistaken these shrinkage cracks for earthquake cracks, but there is ample testimony of unquestionable character to prove that they were in existence years before the earthquake occurred.

It became the writer's privilege about a month after the shock to make a thorough minute examination of the structure in company with an engineer and an architect. Because of our realization of the important part that reinforced concrete would probably take in the reconstruction of the stricken section, our examination was made with unusual care. At the completion of this task it was the unanimous opinion that this structure had suffered no structural damage from the earthquake. It was not subjected to any fire test. Columns, girders and floors showed no cracks or defects of any character whatever. The only item of damage that could be found in the building at all was a hole that had been punctured in one of the floors, this puncture being caused by the falling of a piece of statuary.

That this building had been subjected to a severe vibratory motion was evident in the main entrance. This entrance had a marble wainscoting about 4 feet high and the floor was covered with chips and dust caused by the grinding of the edges of the marble used in the wainscoting. Some of the chips were as large as the thumb nail.

There was just being completed an addition to the Museum building. This was almost ready for occupancy. The construction of the new work consisted of brick bearing walls and concrete floors, the concrete floors being supported by steel girders and columns. All the new work was badly wrecked by the earthquake. It is interesting to know that the University authorities had abandoned the reinforced concrete construction and resorted to this type as being safer. The alarm was caused by the shrinkage cracks that existed in the main Museum building.

This building certainly possesses for advocates of reinforced concrete more interest than any structure in this vicinity, on account of the unquestionable severe ordeal through which it has passed. It will convince all fair-minded persons that a properly constructed reinforced concrete building of such dimensions is a safe and sound structure for earthquakes of as great magnitude as that which occurred in California in 1906. It was the intention and object of Gov. Stanford when he authorized the construction of this building to have on the campus a structure whose strength and durability would be the maximum that could be obtained. That he succeeded, can be doubted by no one who saw the campus after the earthquake.

The writer has heard it stated, and is informed, that this statement exists in print, that the Memorial Arch at the Leland Stanford, Jr., University was a reinforced concrete structure and that it was a complete wreck. I take this opportunity to refute this statement in so far as it pertains to reinforced concrete; the arch was a wreck, but it was constructed of brick.

Fire Resisting Qualities of Reinforced Concrete.—One of the great misfortunes for us is that there did not exist at the time of the fire an all reinforced con-

crete building in San Francisco. Such information as was gleaned from the San Francisco fire on this subject was derived wholly from the behavior of the concrete floors and fireproof columns in some of our steel frames. As in all other places, good, bad and indifferent concrete work had been done, so that the results must of necessity be variable in character. The same faults of workmanship existed, no doubt, in the buildings in which tile was the fireproofing element.

When San Francisco faced the problem of rebuilding, it was a source of astonishment to those interested in construction to see the attention and investigation that was being given to reinforced concrete by the laymen. The public opinion became so strong for this material that the Board of Supervisors were compelled to recognize its merits and permit its use for all building operations.

Its superior fire resisting qualities were recognized by comparing the general condition of such buildings as had used concrete with those which had used tile. The result is that today in San Francisco concrete has been used as fireproofing for the steel frame buildings almost exclusively. There is but one case in the city in which tile was used.

Up to June 30, 1910, there had been issued in San Francisco permits for 132 reinforced concrete buildings. Several permits have been issued since, so that the number to date can safely be taken as over 140. Of this number, 128 are completed structures and being occupied, eight more will be completed within two months, and the balance within six months. The private capital invested in buildings in San Francisco from April, 1906, to June 30, 1910, as shown by the official reports of the California Development Board, is as follows:

Class of building.	No.	Cost.
Class A (steel frames).....	105	$ 23,467,260
Class B (reinforced concrete).	132	9,059,371
Class C (mill construction)...	1,739	53,597,631
Frame	15,844	63,701,643
Alterations	9,491	11,302,231
	27,311	$161,128,136
Addition of 15% for undervaluation....		24,169,220
Total expended to Jan. 1, 1910.....		$185,297,356
Municipal work inclusive of bond issue (city work applies to only contracts actually awarded before Jan. 1, 1910)..		6,150,371
Total		$191,447,727

The concrete buildings constructed have been built by a most conservative capital. Because of the known conservatism of the company, I mention in particular the Southern Pacific Railroad Hospital. This structure cost the railroad about $550,000 and was built of reinforced concrete exclusively.

The concrete buildings in San Francisco have been constructed in the face of one very great obstacle. For some reason, unknown to the writer, the banks have absolutely declined to negotiate loans for this type of construction. Many owners have built in structural steel, where they would have used reinforced concrete but for this difficulty.

State of California.—The state of California through the State Engineers' Department, Nat C. Ellery, engineer, has used reinforced concrete very extensively in the replacing of such state buildings as were destroyed by the earthquake. The State Insane Asylum situated at Agnews, a place 20 miles from the Leland Stanford, Jr., University, has been rebuilt of reinforced concrete. The old structures were entirely demolished in the earthquake, having been built of brick with timber interiors.

Very extensive additions to the State Penitentiary at San Quentin, situated on the bay but a few miles from San Francisco, were made of the same material.

The State Board of Harbor Commissioners.—The State Board of Harbor Commissioners are a body of men who control the improvements of the harbor of San Francisco, and are appointed by the governor for this specific purpose. Since 1906 they have used reinforced concrete very extensively in the construction of wharves. Piers 36-38 and 40 are founded on concrete cylinder piers, which support a series of steel girders. These girders are encased in concrete, and on them rests a reinforced concrete slab which supports the entire traffic of the wharf. Pier 54, which is now under construction and nearly completed, is supported by concrete cylinders. The floor system of this pier, however, consists of a series of girders, beams and slabs, all of which are constructed entirely of reinforced concrete. This is the last pier constructed by the Board of Harbor Commissioners, but they now have in preparation plans for another one that will incorporate the same type of construction as Pier 54. These four piers have a floor area of about 360,000 sq. ft., and cost about $1,090,000.

It is beyond question that our State Board of Harbor Commissioners are being guided by their experiences and investigations in the selection of reinforced concrete for permanent structures on the water front of San Francisco.

San Francisco.—The city of San Francisco has shown its confidence in reinforced concrete in a very emphatic manner. It is well known, no doubt, to you all, that the great fire of San Francisco was caused by the breaking of the water supply pipes on the marsh just south of the city, thus leaving our fire department without any water to combat the conflagration. Before a rebuilt city could be made safe, it was patent to all that some device must be used to protect the city in case the supply pipes should again be broken. It was finally decided to build storage cisterns distributed throughout the city at proper intervals. There have been 80 of these cisterns built in San Francisco, and all of them are constructed of reinforced concrete.

In the new sewer system, for which bonds have been voted in the sum of $5,000,000, reinforced concrete is being used exclusively where the sewers are of sufficient size to warrant. There has already been expended in these reinforced concrete sewers $1,500,000, and the balance of the bond money will be used for this same type.

The County Infirmary building was built of reinforced concrete, and in such steel frames as have been constructed by the city. It is used exclusively for the fireproofing and floor constructions.

Costs.—For the purpose of conveying to you an idea of the relative costs of a reinforced concrete building, and a structural steel frame building. San Francisco is selected as the location of the structure. The prices existing here for labor and material at the present time are as follows:

Cement workers:

Laborers, per day.....	$ 4.00
Finishers, per day.....	6.00
Housesmith:	
Inside workmen, per day.....	4.00
Outside workmen, per day.....	5.00
Carpenters, per day.....	5.00
The cement is worth per bbl., delivered.....	1.90
Form lumber, per M.....	15.00

Gravel or sand, per yard	1.35
Crushed rock, per yard	1.50
Reinforcing steel, per ton	50.00

The building selected is one of six stories and basement, with a floor area of 10,400 sq. ft. on each floor, and a cubiture of 1,088,000 cu. ft. As actually constructed, the frame is of steel with reinforced concrete foundations, basement walls, floor slabs, and intermediate beams. The curtain walls are of brick. The total contract price for the brick work, concrete work and steel frame was about $104,000. This figure was considered very low. The cost of a reinforced concrete frame and curtain walls under the same conditions would not be more than $86,000. A concrete building would have made a saving of $18,000, or a little more than seventeen (17) per cent. It must be borne in mind, however, that the steel frame building had intermediate reinforced concrete beams, which, of course, reduces its cost to a minimum, thus making the above comparison as favorable to steel as possible.

Bridges.—Previous to 1906 and within the territory included in this discussion, there was but one reinforced concrete bridge of any magnitude. This one was a structure consisting of ten 75-ft. spans, built by interior counties for highway purposes. This bridge caused considerable inclination among the county officials to weigh more carefully the merits of concrete bridges. By persistent efforts the concrete men are being able to gradually convince the authorities that the extra cost of concrete bridges over steel is money well expended. The result is that there exists today over 50 reinforced concrete county bridges, ranging in magnitude from 35 to 130-ft. spans in a section that four years ago contained but one. There is now being constructed by one of the interior counties a bridge consisting of seven 200-ft. spans.

The county surveyors, who, under the laws of the State of California, control the designing of bridges for the county, except through a special act of the Board of Supervisors, are rapidly becoming advocates of the use of reinforced concrete. The bridges that have been built in the interior, which embrace flat slabs, girders and arches have done an immense work toward educating the people to understand the possibilities and utility of this material. Two counties of California have, through their Board of Supervisors and by resolutions of the latter, committed themselves to the use of reinforced concrete for bridge purposes wherever possible.

CONCRETE VALUABLE IN ORNAMENTATION

The structural value of concrete has been emphasized as the most important quality of the material and this probably is perfectly natural, because the structural value is the most important quality in the practical sense and it was the first quality of the material to be discovered. This, however, must not be considered, to the exclusion of those other qualities which are making for concrete's acceptability for other reasons.

Concrete lends itself to ornamental work of practically every description and has advantages in the execution of design which no other material possesses.

In the decoration of large structural works the ornamentation frequently is something which is "stuck on." It is an afterthought, or a coating, like paint or a superficial trim, while concrete may be used in effective ornamentation, and at the same time the units of ornamentation serve some structural purpose, so that utility and beauty may truly go hand in hand.

The use of concrete in structural ornamentation has opened up new fields for the architect and within the reasonable limits of the principles of construction he may use the material to express his ideas just about as he pleases. It may be cast in specially made forms right on the job, so that the ornamental features of the design become a part of the structure itself—a true monolith in which supporting walls, cornices, columns, arches and so on are in one piece.

Still more intricate effects may be produced by casting special building units in factories and removing them like cut stone to the job. A wood or plaster mold or even a glue mold for a special unit to be cast in concrete may be constructed in the factory at less labor cost than goes into the cutting of one piece of natural trim stone. So that if a given unit of design occurs more than once in a structure, as is usually the case, the cost of each piece cast in the mold is reduced proportionately.

The visible surface in this ornamental work in concrete may be treated to produce almost any effect of light or shade, color, tone or texture.

A very ordinary mixture of concrete may be used throughout the mass of the unit and yet the surface area, and to whatever depth desired, may be made of such special aggregates and coloring materials as best suits the design; or the builder has a choice of numerous after-treatments, either in scrubbing the surface with wire brushes before the concrete has become too hard or with acid treatment, rubbing bricks, sand blasting or tooling. These treatments are not by any means limited to the factory where unit pieces are made. Practically all of them are as readily applicable to the concrete work which is done in mass and afterward subjected to surface treatment.

In the earlier uses of concrete the material failed to find favor with many architects. It is not at all surprising that they did not take kindly to the use of a material which depended for its value upon an imitation of some other building material.

This was one of the early mistakes in the use of concrete. The fact that it might be cast in a mold to meet any whim of the molder, led in the most natural way in the world to the attempts to produce forms, textures and colors like those of other well-known materials. Early workers lacked imagination. They had so long been accustomed to the use of building stone in various shapes and varieties that they were let into imitation, not at all commendable, and not at all likely to bring out the best qualities of the material in which they worked.

The ordinary mind naturally abhors that which is merely imitative. Many of the near-stone houses erected in the early days were not a good advertisement for the material of which they were built.

It is true that facsimile stone has been made and is being made which only experts can detect when laid up in a wall along with the real stone from which it is patterned. There is a wide use for such material. But this use is not the best use which can be claimed for concrete by any means.

The best concrete work is that which says proudly upon its face: "I am concrete." It has qualities distinctly its own—very much better than any which are purely imitative.—Columbus, Ohio, News.

The McDonald Spiked Concrete Tie Co., Los Angeles, Cal., is sending out a small pamphlet showing a large number of illustrations of the process of making its patent reinforced concrete railway tie. The shape and method of reinforcing is shown plainly in several diagrams. Photographs are also shown of a number of installations of these ties in steam and street railways.

Drain Tile Investigations at the Engineering Experiment Station, Ames, Iowa

By A. O. Anderson

The problems relating to drainage being one of the important matters in Iowa, not alone for the engineer, but for the agriculturist as well, it was deemed expedient that the Engineering Experiment Station should devote a generous portion of its time and funds in performing experimental work which would yield data of value to all persons interested in this subject. At present several lines of investigation are being exploited, the principal ones of which will be discussed.

A study of the effects of drainage upon the several kinds of soil found in Iowa, as well as the determination of the most economical depths and distances apart to which tile should be placed in these soils is being carried on jointly by the Station and the Soils Division of the Agricultural Experiment Station. To facilitate these investigations, experimental drainage systems have been installed near Rudd, Hanford, Lake City, Missouri Valley and Moulton, Ia., where the necessary data is being collected.

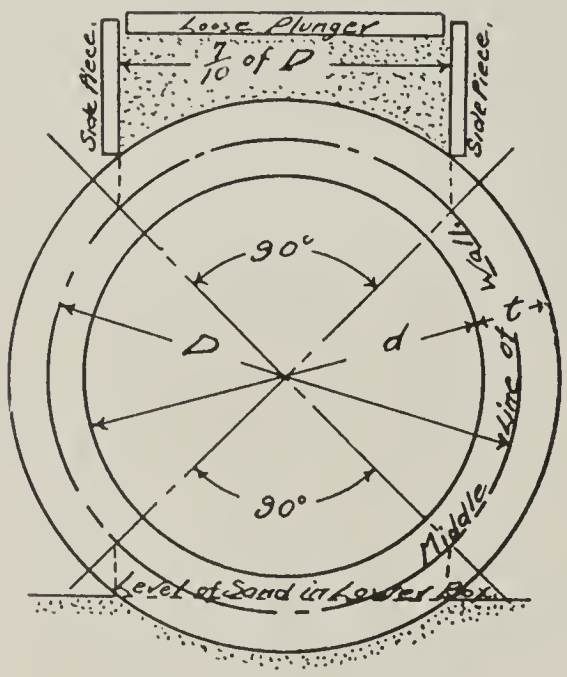


Fig. 1

An investigation is under way which is intended to clear up the matter of the comparative values of the different kinds of drain tile used in Iowa. Several years must elapse before this question can be definitely answered, as the test of time alone can give satisfactory results. Different qualities and kinds of tile have been installed in some of the experimental drains, from which a number are removed each year for testing. Examinations and tests are made on pipe taken from any tile failure reported to the station, and the cause of the failure is determined where possible. Besides this, engineers throughout the state are generous in furnishing data concerning failures which are not directly investigated.

When the investigation concerning the quality of drain tile was first undertaken, it became evident that some uniform method for testing the pipe must be adopted. As none of those methods in use were satisfactory, Professor A. Marston and his assistants designed one which is rapid and uniform in results, besides imitating very accurately the actual conditions to which the pipe must conform when placed in the drain. The principle of the method is illustrated in Figure 1.

It will be noticed that the pipe is supported on a cushion of sand covering the lower quarter of its circumference, while the load is applied to a similar cushion placed on top of the pipe, the latter being retained in place by a bottomless box so arranged that all of the pressure is transmitted to the pipe through the sand bed. This method for testing pipe has been in successful use for several years, and has been adopted as the standard for Iowa by the engineering society, and the two associations representing the drain tile and sewer pipe industries of the state. An advantage of the Ames standard method for testing is the facility with which it may be used, as no regular testing machine is necessary.

However, the need of a reliable testing machine which could be easily constructed at a moderate cost became evident, if the testing of drain tile and sewer pipe were to come into general use. To meet this demand, three types of machines were designed which could be built by any mechanic at costs ranging from thirty to one hundred and fifty dollars. These machines are adapted not alone to testing of pipe by the Ames standard method, but are applicable to any method used for bedding the pipe, as well as for the testing of posts, beams or other material within the capacity of the machine. Figures 2 and 3 illustrate the Ames senior machine, blue-prints of which will be sent to interested parties upon application to the Director of the Engineering Experiment Station.

The interest taken in this work is shown by the fact that not only do the people of Iowa send tile for testing, but several carloads have been sent in from adjoining states. Many injuiries concerning the testing machines and methods have been received from various states of the union, as well as from several foreign countries.

A method for the testing of sewer and drain pipe having been developed, it would seem that the difficulty of drafting standard specifications for this material had been overcome, since it would only be necessary to specify the quality of material to be used and the bearing strength of the finished article. But when information concerning the requisite strength of the pipe, or the load that it must sustain at various depths was sought, no reliable data was found. A number of formulae which might be used as the basis for calculation were at hand, but these required friction coefficients which no one had accurately determined. This being the case, it became evident that the station had another task on hand, namely, the determination of the actual pressure to which the pipe and tile are subjected while in the ground, and to establish reliable co-efficients and formulae for the calculation of these pressures.

Several methods for conducting this investigation were proposed; the one adopted is shown in Figure 4. This consists in placing a number of tile in a trench of the desired depth and contour, and supporting them by means of a beam suspended from a weighing apparatus. The character and capacity of this apparatus may be judged by the fact that pressure readings approaching fifty thousand pounds have been taken. The method of conducting a test is as follows:

After the trench has been excavated to the desired depth and contour, zero readings of depth and pressure are taken, and the filling begun. All the filling material is weighed as it is deposited, and friction

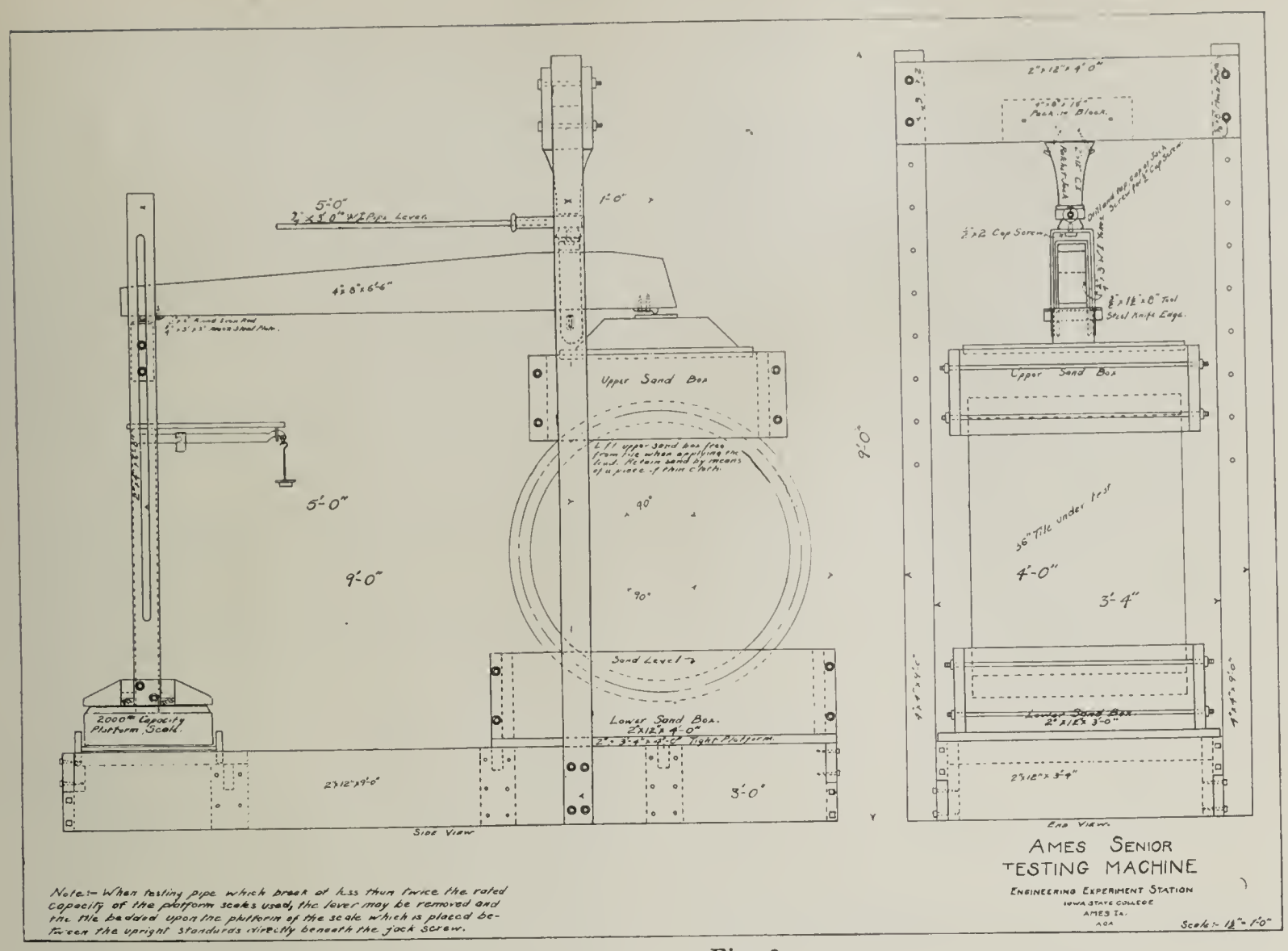


Fig. 2.

material as well as its sliding friction against the bank of the trench. These friction values are used in checking the several formulae for earth pressures under intests made to determine the internal friction of the vestigation. At stated intervals, the depth of fill is measured and a scale reading taken which gives the actual pressure on the pipe for that depth of fill. After allowing a few days or weeks to elapse, during which the changes in pressure and settlement of fill are noted, the whole apparatus is dug out and another test begun.

The scope of the work done may be illustrated by the fact that tests of pressures on pipe from twelve to thirty-six inches diameter under fills varying from one foot to seventeen feet in depth have been made, and the effect of vertical and sloping sides on the pressure, the effect of different degrees of saturation of the filling material, and the effect of superimposed loads for several different depths of filling have been investigated.

The investigation of the problems relating to pipe and tile is but a part of the work being done by the Station, and represents the effort of but one of the six sections of its organization. The other branches are studying problems peculiar to their own line of work. The results of these investigations are published as bulletins as fast as the work is completed, and these same may be secured upon application to the Director.

MR. STUART SMITH.

Mr. Stuart Smith has accepted the position as Chief Chemist of the Superior Portland Cement Co., Ltd., Orangeville, Ontario, Canada.

Mr. Smith has ten years' experience in the Portland Cement Industry and served in the chemical engineering departments of the Lawrence, Alpha and Atlas Portland Cement companies of the famous Lehigh district and the Marquette Cement Mfg. Co., LaSalle, Ill. This latter company Mr. Smith served as chief chemist for five years.

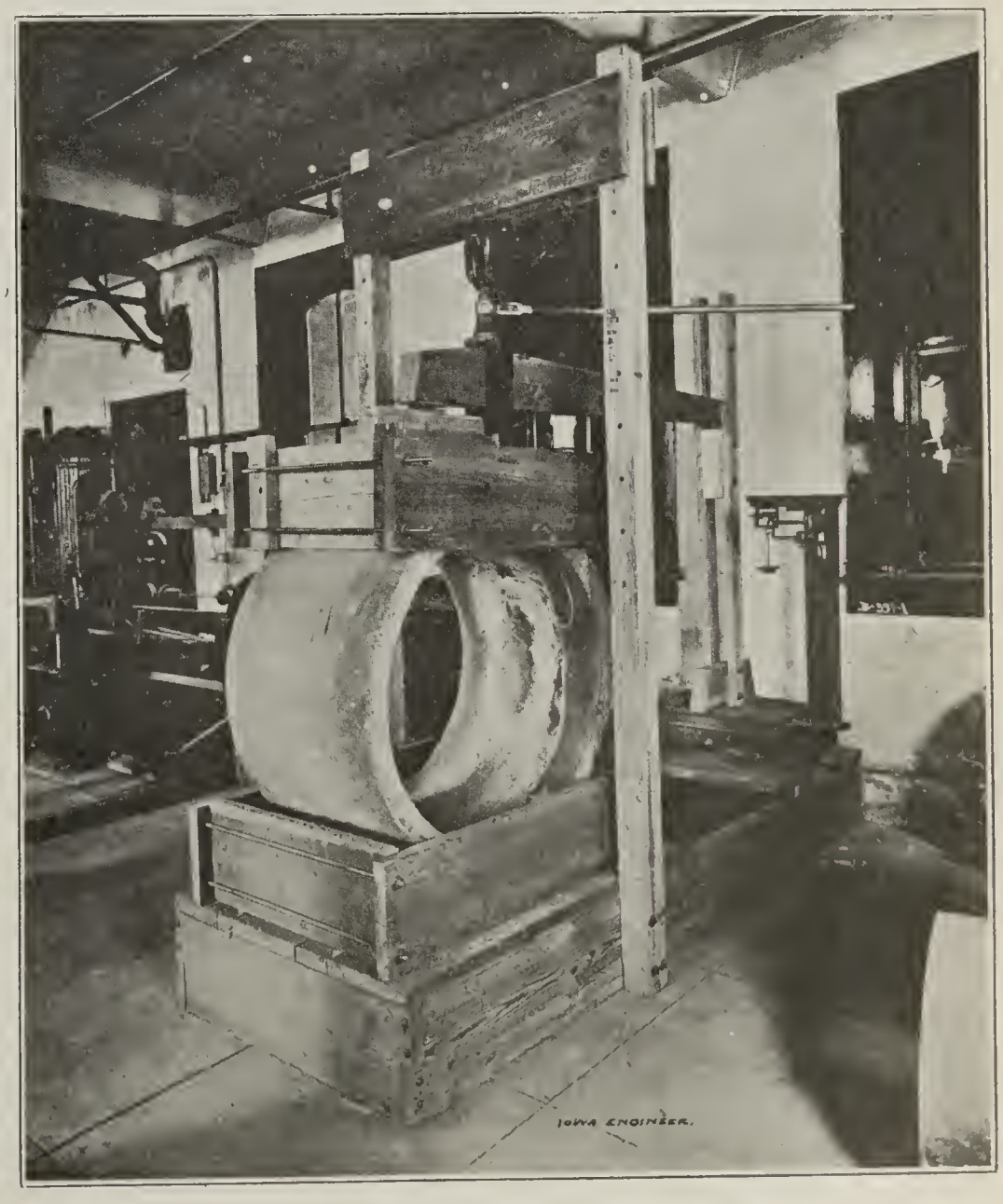


Fig. 3.

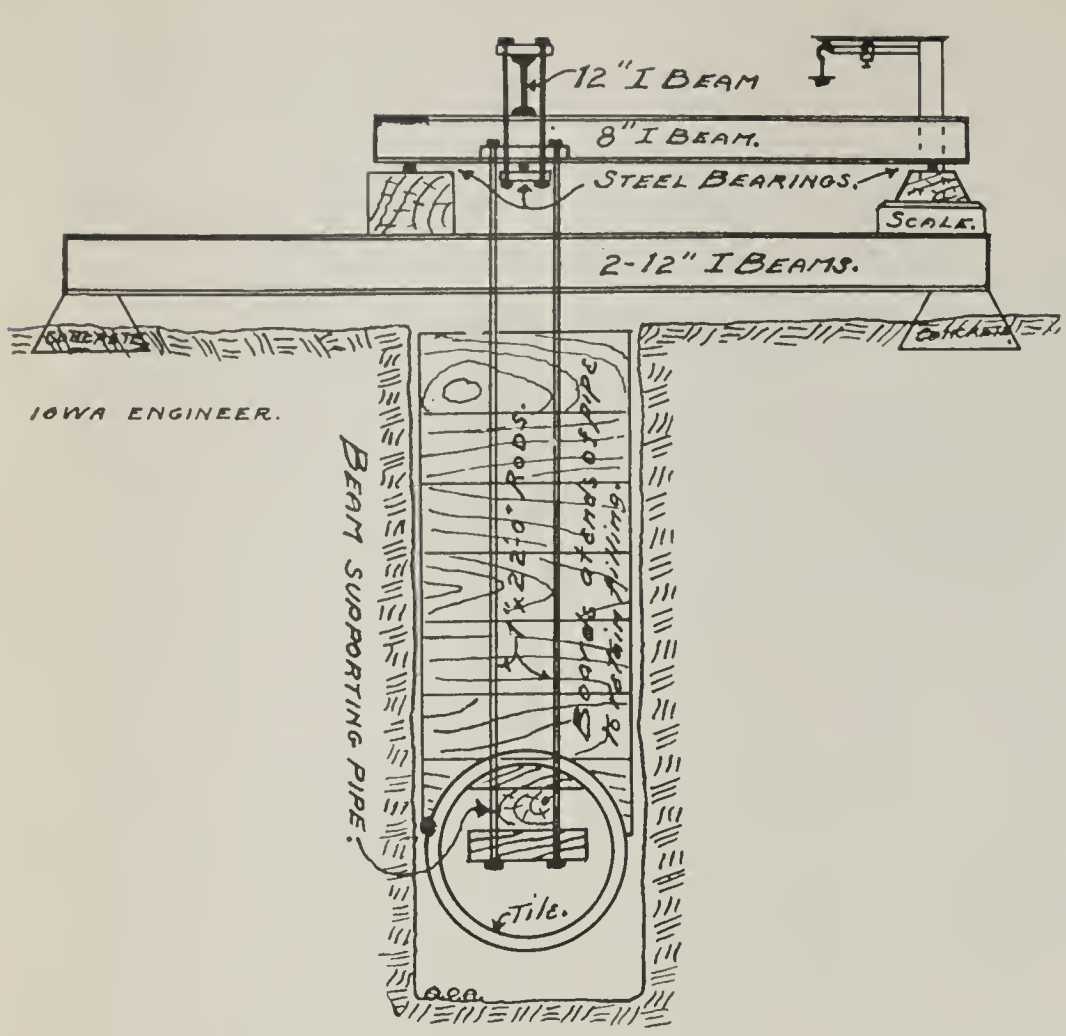


Fig. 4.

COMPARATIVE TESTS OF CEMENT GUN CONCRETE AND HAND APPLIED CONCRETE.

A series of tests of very interesting character was made recently by the engineering firm of Westinghouse, Church, Kerr & Co., for the European Cement-Gun Co., 30 Church street, New York City, with a view to determining whether concrete surface coatings applied by the new air-blast device known as the "Cement Gun" are equal to or superior to hand-applied coatings.

For these tests, sample coatings were made by both hand and cement-gun processes, and tests were carried out for tensile strength, crushing strength, surface permeability, absorption, percentage of voids or porosity, and adhesion to other materials, such as brick, stone and iron.

Portions of the report rendered by the engineers were published in the December issue of The Mason Builder, where the full tables of results are given. The following extracts indicate the general tenor of the report.

It was found that all the tests showed distinct superiority of the cement-gun concrete to the hand-applied concrete. In the case of tensile and compressive strength, an advantage of 20 per cent to several hundred per cent was shown. Permeability and absorption showed values for the machine coatings fully one-third less than for hand-applied coatings. The cement-gun products also was found to be more dense. In the adhesion tests, while the figures obtained were greatly variable, the hand-applied cement was, nevertheless, distinctly inferior.

Summaries of the tables of results are given below, as representing fairly the general nature of the results. In all cases the tests included mixtures with different sands, but we have generally selected those made with standard Ottawa sand for the purposes of this comparison. Cement-sand mixtures ranging from 1:3 up to 1:7 and even leaner were tried. Some of the tests included samples made with lime admixture. Our extracts generally represent the results for 1:3, 1:4 and 1:5 cement-sand mixture. But it is important to note that the cement-gun coatings were really richer than the original proportions of mixture, as stated in a note at the foot of the tables.

While the conditions of experimentation are not fully stated, it would appear from the tables that the cement-gun concrete has normally a tensile strength nearly double that of similar hand-applied coating, and a compressive strength ranging possibly 50 per cent higher than that of the hand-applied coating. The permeability results given in our extract, ranging from a ratio of 0.19 to 0.70, suggest that the cement-gun coating gives normally quite distinctly more resistance to the entrance of water than hand-applied concrete. The absorption and porosity tests clearly indicate greater density of the coating applied by the machine.

The original report (but not the Mason Builder reprint) states that both kinds of coatings were made with special care so as to secure the best test specimens possible. The report contains the following conclusions:

TENSILE TESTS

(with standard Ottawa sand)

Tensile Strength, Lb. per Sq. In.

	7 days			28 days		
Mix.	Hand	Gun	Ratio Gun to Hand	Hand	Gun	Ratio Gun to Hand
1:3	214	463	2.20	290	661	2.30
1:4	164	346	2.1)	222	601	2.70
1:5	108	530	4.90	148	540	3.60

CRUSHING TESTS

2-in. Cubes. Tested at age of 28 days
(with standard Ottawa sand)

Crushing Strength, Lb. per Sq. In.

Mix.	Hand	Gun	Ratio Gun to Hand
1:3	2406	2936	1.2
1:4	1770	3459	2.0
1:5	1740	2949	1.7

PERMEABILITY TESTS

At age of 5 weeks
(with fine beach sand)

Water Absorbed by a Surface of 0.02 Sq. M., C. C. per Hr.

Mix.	Hand	Gun	Ratio Gun to Hand
1:3	43.5	8.2	0.19
1:4	21.9	11.2	0.51
1:5	50.3	35.0	0.70

ABSORPTION TESTS

At age of 28 days
(with standard Ottawa sand)

Percentage Absorption

Mix.	Hand	Gun	Ratio Gun to Hand
1:3	3.5%	0.66%	0.19
1:4	4:4%	1.11%	0.25
1:5	4.6%	1.04%	0.23

POROSITY TESTS

At age of 90 days, using specimens from absorption tests
(with Cow Bay sand)

Percent Voids

Mix.	Hand	Gun	Ratio Gun to Hand
1:3	19.2%	12.7%	0.66
1:4	22:6%	15.1%	0.67

Note—The figures given in the column "Mix" refer to the proportions or materials supplied. The cement-gun process caused enough scatter of sand to make the applied coating considerably richer. It is estimated by the engineer of test that the mix marked 1:4 gave, when used in the "gun," a coating of about 1:3 proportion. If this fact is taken into account, the comparison would come out somewhat less disadvantageous for the hand-applied coatings.

"In all the tests made, the product of the cement-gun showed superior to good hand-made product of the same kind. The degree of superiority varied between wide limits.

"In tensile strength the gun work excelled hand work in every case by amounts ranging from 20 per cent to 260 per cent.

"In compressive strength the excellence of the gun work was even more marked, ranging from 20 per cent to 720 per cent better than hand work.

"In the matter of surface permeability the gun work absorbed from 7-10 down to 1-20 as much water per hour per unit of area as the similar hand work surfaces.

"As regards absorption of water, the hand made mortars took up from 1.4 to 5.3 times as much as the gun made mortars.

"The percentage of voids of the gun made product ranged from 52 per cent to 75 per cent of that of the hand made product.

"The adhesion of the gun-applied mortars was, on the average, 27 per cent better than that of the hand work."

The table summaries here given do not contain the results of the adhesion tests. The mortars used in this tests were of 1:4 mixture. A number of the hand made specimens broke before testing, and the comparison is thereby vitiated. The average results of those specimens which did not break before reaching the time of test were, for gun-made concrete 465 lbs. per sq. in., for hand made concrete 365 lbs. per sq. in., giving a ratio of gun to hand concrete 1.27.

The above notes and our extracts from the tables include some data not contained in the Mason Builder reprint, but supplied by Mr. Cloyd M. Chapman, the engineer who conducted the tests. For closer study of the subject, the full tables should be consulted, in the source mentioned.

INSPECTION OF CONCRETE.

By E. A. James.

Although concrete was a material of construction in the days when the Roman Empire flourished, yet we speak of it as one of the modern materials of construction. For several centuries other materials were more convenient and more fashionable, and with the settlement of America the plentiful supply of timber and the ease with which it was made suitable for construction work, marked timber the cheap material of construction and it was not until the '70's that cement and concrete again entered into construction work in any great quantities.

Where the uses are so varied as are those to which concrete is placed, it is but natural to expect to hear of failure, and where the amount of money expended annually is so large, it is reasonable to suppose that every effort should be made to insure good work.

In concrete work, as in other classes of construction, good design and good materials are necessary, and granting that we have good design and good materials, a class of well-skilled workmen should produce a finished material of a high order.

Concrete, however, has suffered more than any other building material because of inferior workmen, and this has been brought about largely by those interested in the early days in the sale of cement, who claimed as one of the chief reasons why it should be largely used, was the cheapness of placing, because it did not require skilled laborers.

Fortunately we do not hear so much of the claim as formerly, for it is well recognized that workmen can, with the same ingredients, produce various grades of concrete.

Although among the first of the modern concrete structures many were well and substantially made, yet there were a number of serious failures, and because the engineers themselves were not any too familiar with concrete construction, and because of this recurring failure and the fact that most of the workers in concrete were men imperfectly skilled, a system of careful inspection was inaugurated.

While the necessity of inspection depends to a certain extent upon the nature of the material and the production, it is always a question of just when and where, and to what extent it pays to inspect. In concrete work inspection must be made of the component parts. The sand, the gravel, the cement and the water must be examined, as well as the concrete while it is being mixed and poured.

The scope and possibilities of a system of inspection enlarges greatly with specialization.

Inspection should be planned to accomplish at least expense the best results, which may be numerated something as follows:

1. To prevent loss or defects by accidents or delays.
2. To prevent loss of time and material on work already beyond repair.
3. To prevent the necessity of replacing defective work.
4. To prevent decrease in quality because of the demand for increase in quantity.
5. To point out imperfections in alignment, methods and material.
6. To record proper allowances for unavoidable extras.
7. To draw the attention of the superintendent to workmen who must be better instructed or trained.
8. To stimulate good will through fairness, in fixing responsibilities.

Inspection organized to cover any one or all of these purposes, will be similar in personality, varying only with the degree of perfection required.

Before it can be determined just when and where it pays to inspect, the following conditions must be satisfied:

1. Responsibility must be fixed with certainty.
2. The inspection must not cause unnecessary friction.
3. The inspector must have to do with quality only, not design.
4. The responsibility for defective work must be placed upon the workman as well as upon the inspector.

Responsibility Must Be Fixed with Certainty.

As inspection has for its purpose the pointing out of the defects, it is necessary for the inspector to be able to locate the cause of the defect. One of the most foolish things that can be done is attaching blame to the wrong person, and unless it is possible to discover immediately just when and where the cause of the defect lies, the fixing of responsibility is very difficult. It is therefore necessary to have the material on the ground in sufficient time for thorough inspection before it is mixed, for even after the inspector has detected the defect, the responsibility is not necessarily fixed. The error may be due to wrong specification, poor material, defective measurement, defective mixing, or even unsuitable weather conditions. It is therefore necessary that instructions and specifications be in writing.

Inspection Must Not Cause Unnecessary Friction.

No system of inspection which would simply complain of defects, without attempting to trace the cause or to assist in the improving of conditions, will be of any assistance. It certainly would not tend to happy

relations between contractor and engineer. So it becomes necessary, if full benefits are to be derived from rigid inspection, not only to point out the defects, but the inspector should be in a position to trace the cause and to suggest a remedy. Defective work must be detected as soon as possible, so that the conditions under which the work was done may be fresh in the workman's mind, and the responsibility with certainty attached to him when the defect is through careless workmanship.

The Inspector Must Have to Do with Quality Only, Not Design.

To point out defects will not necessarily stop the repetition, and although it may be the duty of the inspector to trace the cause, fix the responsibility and suggest the remedy, the inspector must not have to do with applying the remedy or of interfering with the workmen.

When the inspector has reported defects in material or workmanship to the engineer and contractor, or their representatives, he must content himself with awaiting the corrections through the proper officials although it should be within his power to stop or reject the work until there is an opportunity for investigation, and to take upon himself these responsibilities he must have knowledge equal to that of the superintendent of the work.

Responsibility for Defective Work Must Be Placed Upon the Workman as Well as Upon the Inspector.

While we have stated that the inspector should not interfere with the workman, yet the knowledge that he is present will have a disciplinarian effect and will prevent the sacrifice of quality for quantity. Inspecting alone will not reduce bad workmanship to a minimum, but the workman must be supplied with proper tools, proper instructions, and must be trained in his work and held responsible for the quality of his work. He must be trained to inspect his own work. We have known cases where the men were paid a bonus for saving cement, and where this is the case it almost requires as many inspectors as men to secure compliance with specifications. Where it is known that the contractor is encouraging his men to skimp the work the inspector should lay his information before the engineer, and at once vigorous measures should be taken to remove such contractor from the work, for he will not do good work, no matter what the inspection is.

Plan of Inspection.

There are many plans of inspection, any of which may get good results, and all of which may fail in securing good results. Inspection depends more on the inspector than upon the method.

You may have inspection by central bureaus which retain men who are experts in their line of work who report first to their bureaus, or to the engineer in charge of the work, as may be arranged.

You may have inspection by your own local staff or foreman, or you may require such guarantees that inspection at the end of one or two-year period will be all that is necessary. The plan of inspection to be adopted will necessarily depend on the character of work being carried out.

The Duties of the Inspector.

It should be the duty of the inspector to see that all forms are erected on the lines laid down by the engineer, that these forms are stiff and well braced, and that all material and workmanship are in accordance with the specifications. He should look after the removal of forms and see that the concrete is not injured in the removal.

Aside from concrete walks, form work is the most difficult to get properly placed, and it is much easier to develop a good inspector out of a good carpenter than out of a good concrete worker.

If the work is to be done at night under artificial light it will be necessary to increase the staff of inspectors, for concrete that can be detected in the day time, by color, will not show lack of proper mixing of materials under artificial light. In fact, where high-class work is required, or in finishing surfaces, as a rule it is better not done at night at all.

The cost of inspection is variable, being in some cases as low as one per cent of the total cost and as high as two and one-half per cent. I think it is a usual thing two per cent should be allowed for inspection, and good inspection is cheap at that price.

THE REINFORCED CONCRETE PIPE CO.

The Reinforced Concrete Pipe Company with offices and factories at Los Angeles, San Francisco and Portland, Oregon, publishes an elaborate catalog containing numerous illustrations of the varied uses to which their reinforced concrete pipes have been put in the Pacific Coast states. The cuts show the method of reinforcing, the devices employed in laying the pipe and the ways of testing the pipe for compression strength. On the following pages we publish several of these cuts in order to give our readers an idea of this valuable publication and of the kind of work turned out by the Reinforced Concrete Pipe Co.

60-inch Reinforced Concrete Pipe Made by Reinforced Concrete Pipe Co. of Los Angeles.

LEHIGH PORTLAND CEMENT CO.

The Lehigh Portland Cement Company, which is one of the leaders in that industry, has announced an increase of its capital stock from $8,000,000 to $12,000,000. It is understood that virtually all of the additional stock has been subscribed for. The increase is to capitalize expenditures for the erection of a cement plant at Mason City, Iowa, and one at Spokane, Wash., each with a capacity of about 1,500,000 barrels per annum.

FIGHTING FIRE WITH CONCRETE.

That the world did not sooner reach a condition of decided development, and that it still lags behind reasonable expectations, is not chargeable to a lack of all forms of material with which to work, but rather to inability and lack of wisdom on the part of workers. Nature has been so bountiful in bestowing gifts that man has hitherto been unable rightly to understand, much less appropriate and employ, many of them.

A pointed instance of this is furnished by concrete. The materials for its production have existed throughout the world in most lavish profusion since the "water receded." More than that, concrete, somewhat similar to that of our day, was freely used two thousand years ago. Yet, despite the inviting supplies of material and the object-lessons afforded by past experience, Portland cement was not invented and perfected until a time well within the limits of the last century, and did not come into anything like general use until quite recent years. Indeed, in this regard, it may properly be said to be in its infancy. Vast as is our present production of Portland cement, it will appear almost insignificant twenty years hence.

Stock Pipe in No. 2 Yard of Reinforced Concrete Pipe Co. This Pipe Carried in Stock for Culverts for Railroad Companies and Los Angeles County.

Not only is concrete being employed for a wide range of construction purposes, but is tending to improve building in general, by supplying a splendid material that can be cheaply, effectively, and even artistically used, while at the same time providing admirable protection against that great destroyer of American buildings and American lives—fire. This is seen in the ever-increasing production of what may be termed "industrial buildings."

The modern industrial building is a recent development due to the genius, experiment, and untiring industry of engineers and architects. Such buildings, devoted to manufacturing purposes, have overcome the dangers and difficulties that formerly attended the location of factories in the crowded sections of great cities. Despite the possibility, the entire practicability of constructing safe and healthful and practical industrial buildings, their number is not yet large as compared with those that do not fall within that category. Had the New York building in which 140 men, women and girls met death in a horrible form, been a modern industrial structure, no lives would have been sacrificed, and the property loss would have been small. But the great disaster will not altogether prove destitute of compensations. Already strong movements, looking to better protection and fire prevention for buildings in which large numbers of workers are employed, are under way in numerous cities. In the development of these movements concrete is destined to play a most important part. Many wise and enterprising owners and manufacturers learned the lesson without waiting the advent of a teacher in the form of the "fire fiend."

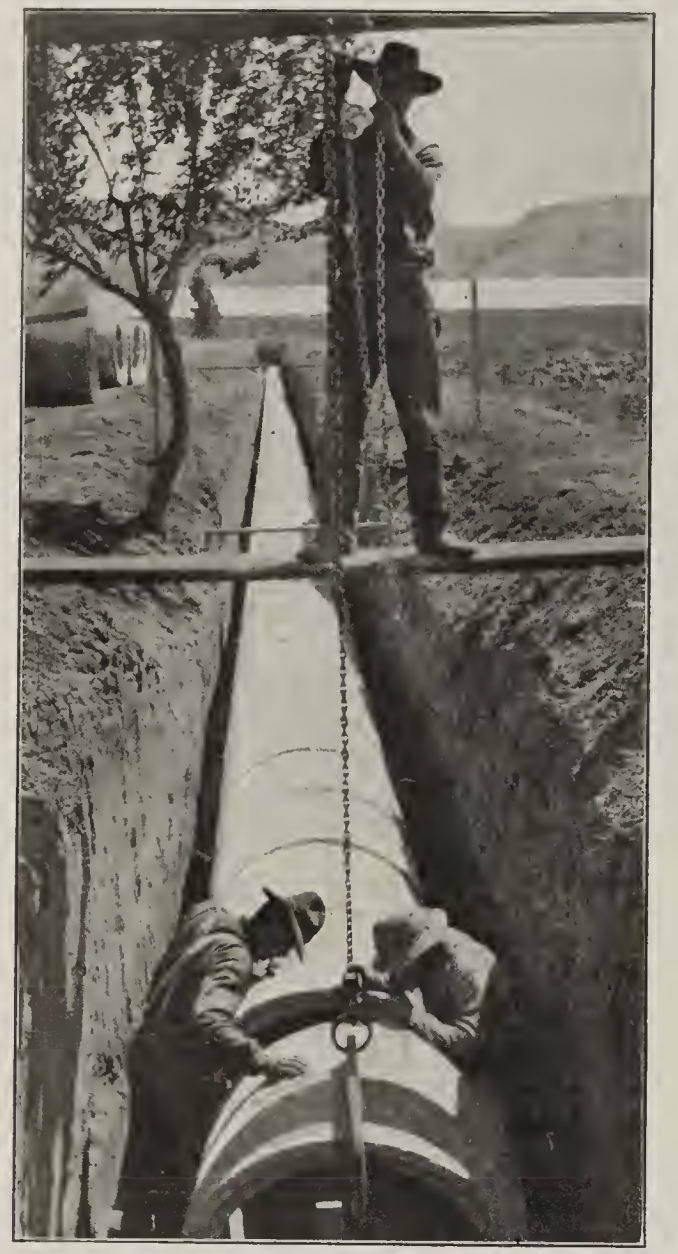
The most modern and best of the industrial buildings thus far constructed are of two general types—structural steel and reinforced concrete. They contain large windows, placed as close together as possible, to provide the largest attainable degree of light. Their walls are possessed of great solidity, and the best possible ventilation is provided. In their construction, wood is eliminated as far as possible, the floors being of concrete, usually with a thin layer of wood—or some other material. The rooms are large and stairways are of concrete. Every really modern industrial building contains enclosed fire escapes, which vary in number according to the height and area of the structure. In effect these escapes are large, brick-inclosed vaults, provided with concrete stairs.

The central idea underlying modern fireproof construction, may well have been suggested by the ordinary stove or furnace, which consumes fuel when placed within and ignited, but is not inself burned or in any manner injured. In fireproof construction, whether of a building or ocean liner, the fundamental idea is to restrict possible fires to the smallest volume and, even more particularly, to the narrowest possible area.

In carrying this basic principle into practical effect, it is necessary to have walls, floors, and partitions constructed of inflammable material, which invites, almost necessitates the employment of concrete, and that on a liberal scale. To further insure safety, the windows must be amply safeguarded; and this is ac-

complished by employing metal frames, glazed with wire glass or else protected with metal shutters that can be instantly and reliably closed. All doors must be of metal or metal-covered wood, and so arranged that they close automatically. Ample fire-walls must be provided, and in all stairways and elevators walls inclosed in fire-resisting partitions.

These and other decided improvements, such as hose lines, automatic sprinklers, and fire alarms, have, in a manner, been a development, an evolution, in which numerous architects, engineers, and builders have participated, each contributing something of value. To these men too large a measure of credit cannot well be given. To their efforts thousands owe their lives, and the number of those rendered secure



36-inch Reinforced Concrete Pumping Line, Spreckles Sugar Co., Replacing Steel Pipe, Spreckles, Cal. Reinforced Concrete Pipe Co.

from death will decidedly increase, as the good sense and humanity of owners and manufacturers, spurred on by the force of public opinion forces the construction of fireproof and fire-protected industrial buildings.

Reinforced concrete is fast coming to be recognized as a splendid material for constructing industrial buildings, and concrete is being freely employed in such structures when primarily of steel construction. Former failures, due to hasty construction, are now disappearing under the employment of scientific and careful methods. It is, therefore, not stating the case too strongly to suggest that concrete is to be the fire-fighing material of the future. It is already being freely employed in this capacity, and its availability is being constantly extended. The coming modern and model industrial building will be constructed largely, in large numbers of instances entirely, of concrete.—American Contractor.

ELECTROLYTIC CORROSION OF STEEL IN CONCRETE.

The possible danger to reinforced concrete structures from electrolysis began to be frequently mentioned five or six years ago. Since then a half-dozen laboratory studies have been made and the results published. These last experiments not only review and confirm the conclusion of previous experiments, that electric currents will cause failures in reinforced concrete, but they throw light on several matters not made clear in previous experiments. These are briefly the resistance to electric currents, or conductivity of concrete; the weakening effect, if any, on concrete, of passing electric currents through it; the possible efficiency of insulating coatings applied to the concrete or the reinforcement; the possible value of mixing or impregnating the concrete with some non-conducting material, etc. The experiments, in brief, tell us more of the possibilities of overcoming the danger of electrolysis than of the certainty and nature of this danger, and for this reason they are particularly interesting to engineers.

Reviewing the data at hand, we may feel certain that electric current may cause failure in reinforced concrete. The nature of this failure is not chemical, or at least not principally chemical disintegration, but is mechanical. Electrolytic corrosion of the reinforcement occurs, by which one volume of the original metal becomes 2.2 volumes of another substance, and this increase in volume ruptures the concrete surrounding the metal. It is clear that dry concrete is a fairly good insulator, and that its conductivity increases with the presence in it of moisture, and with the nature of the salts in solution with this moisture. It is further clear that the passing of an electric current through concrete does not materially affect its cohesive properties; that is, its compressive strength is not decreased by such action. These conclusions may be modified by further test data, but it is reasonable to believe that they will not in the main part be reversed.

With the nature of the danger to reinforced concrete of electric current thus definitely defined, one is in position to study methods of avoiding the danger. The authors of the papers contemplate several possible methods and present test data and discussions bearing on them. One method is to keep the iron negative in respect to the concrete, so that the current will be from the concrete to the reinforcement. This will accomplish the result desired; but it is a laboratory possibility only to secure the requisite conditions. Another method, which is likewise a laboratory possibility only, is confining the current to alternating currents of equal positive and negative wave forms. A third method, which seems at first glance more promising as a practical resource, is to render the concrete non-conducting by filling the pores with some non-conductor or by an insulating coating. Tests made with blocks treated by the Sylvester process (soap and alum) showed no particular value for the treatment. The possibilities for an insulating paint appear small in actual construction work; the concrete must be dry before the insulation is applied, the material must be completely insulated, and the insulation must remain intact and in good condition.

The three methods so far referred to for overcoming electrolysis are based upon the idea of either

changing the nature or direction of the current or of securing a concrete which will be a perfect insulator. The next thought naturally is: Can the reinforcement itself be protected? Two possibilities of this nature suggest themselves. One is to coat the steel with some metal which will make the conduction of the current from the steel to the concrete metallic instead of electrolytic; the other is to cover the steel with an insulating compound which will cut off all flow of current from the reinforcement to the concrete. The tests made to determine these possibilities give rather negative results. They indicate that an aluminum plated reinforcement may quite likely solve the problem, and that a paint has yet to be found which will be a perfect and permanent insulator, assuming that coating reinforcement with paint has no other objections.

At this point it is instructive to notice the results of the tests made to determine the effect of a paint coat on the shear or holding power of steel embedded in concrete. It seems likely that engineers will be loth to give up efficiency in holding power to the extent indicated, for anything less than a very serious menace not otherwise possible to escape.

Summarizing the facts which are presented by these laboratory studies, we obtain the general conclusion that electric current can cause electrolytic corrosion tending to destroy reinforced concrete, and that no practicable means as yet, offer themselves for preventing this corrosion where the dangerous current is present. Theoretically this appears to be somewhat appalling; practically it is not easy to work up a very high degree of terror over it. Like the corrosion of steel skeleton buildings so frequently prophesied some years ago, the possibilities for trouble are great, while the probabilities are negligible. An isolated reinforced concrete structure is not so very easily got at by electric current in a manner to cause grave danger. In the nature of things, too, the places where damages will occur are those where considerable damage in detail can occur without injuring much the integrity of the structure as a whole.

In the above connection, special interest attaches to the recently issued draft report of a standing committee of the British Concrete Institute, on the rusting of steel in concrete. The report is based on replies received in response to a circular letter sent early in 1909 to 1,000 engineers and others engaged in concrete construction, asking for the results of experience and investigation as to whether rusting of steel takes place when the steel is embedded in concrete. The following are the conclusions of the committee:

"Reinforced concrete will last as long as plain concrete in any situation, provided that certain special precautions are taken during its construction. The precautions to be taken are as follows:

"The materials (cement, sand, and stone) must be of good quality. They must be most carefully and thoroughly mixed and scientifically proportioned, so as to be practically water-proof and air-proof. The mixture must be fairly wet, and must be well compacted into position so as to minimize voids. The aggregate should be as non-porous as possible, and any aggregate which is known to have a chemical action on steel should be avoided. The aggregates should all pass through a ¾-inch mesh. The concrete covering should in no case be less than ½-inch; and it is suggested that if round or square bars are used, the covering should not be less than the diameter of the bar. In structures exposed to the action of water or damp air, the thickness of covering should be increased at least 50 per cent, or the size of the aggregate should be so as to insure a dense skin. In the case of structures exposed to very severe conditions, the concrete might be covered with some impervious coating, as an extra precaution.

"The reinforcement should be so arranged that there shall be sufficient space between one piece and its neighbor to allow the concrete to pass and to completely surround every part of the steel. All steel should be firmly supported during the placing of the concrete, so as to avoid displacement. It should not be oiled or painted, and thick rust should be scraped and brushed off before placing."—Engineering and Contracting.

60-inch Reinforced Concrete Storm Sewer, Switzer Creek, San Diego, Cal. Manufactured by Reinforced Concrete Pipe Co., of Los Angeles, Cal.

CRUDE PETROLEUM FOR PRODUCING POWER.

The Wisconsin Engine Company, of which Edward T. Adams is president, has perfected a plan for producing power from crude petroleum, unrivalled in cheapness and efficiency. An epoch-making discovery in gas engineering has thus been brought to a practical, commercial basis.

The invention is the adaptation of the producer gas engine to gas created from crude petroleum by a method so simple as to commend itself, at sight, to every practical engineer.

It means nothing less than a revolution in marine power, and next in usefulness will be its application to the reclamation of land in the arid sections of the world.

Edward T. Adams, who is one of the foremost engineers in America, well known in California as well as the east, the man who built the mammoth gas engine plant of the Steel Corporation at Gary, Ind., and now president of the Wisconsin Engine Company, and his assistant, Nesbit Latta, are the men responsible for bringing to commercial efficiency, by a system of control, the oil gas making invention of a Californian, Arthur Grine. No problems remain doubtful because the oil producer gas system is so simple that, like most great discoveries, it demonstrates itself.

The benefits of such a discovery are beyond computation. Like telephony and telegraphy, it is epoch making. It means an increase of available fuel supply and an up-lift of efficiency in the production of power at low cost, such as no previous combination of elements has introduced into the equation of human progress since the discoveries of steam and electricity. It is elemental in its magnitude.

36-inch Reinforced Concrete Siphon, Roswell, Idaho. Manufactured by Reinforced Concrete Pipe Co.

30-inch Reinforced Concrete Pipe, Hilleboro, Ore. Manufactured by Reinforced Concrete Pipe Co.

Low grade oils, some of them so poor as to be valueless for refining, and even the residue of refined oils, are all made available at once for human assistance and support. The highest authorities estimate that the heat value of oil in known oil fields is as great, and probably greater, than the resources of all the known coal fields of the world. A uniform supply of crude oil, at moderate price, is therefore promised for us and for many future generations.

The application of this new power to marine uses will alone suggest its wonderful possibilities. The same bunker capacity required to store coal to drive a steam engine or turbine-driven ship 1,000 miles would hold oil enough to drive the same ship 6,000 miles with an oil producer gas engine. A vessel will be able to run alongside a dock, drop a pipe into her hold and fill her fuel tanks as a locomotive takes water. Under the steady working conditions common aboard ship, one gallon of these low grade oils will produce from eight to ten horse-power hours, which is a greater horse-power per gallon than is produced from gasoline. The best steam engine can produce but about half this horse-power for a gallon of oil

Standard Sewer and Culvert Pipe Reinforcement. Method employed by Reinforced Concrete Pipe Co., Los Angeles, Cal.

fired under a boiler and the best steam turbine uses about three times the oil per horse-power. The producer itself is simple, would require less space, would be of far less weight than steam boilers, and is far less dangerous to have aboard ship. Naval constructors have for a year or more, turned toward the gas engine, but up to the producer under discussion, none could be built to exceed 400 or 500 horse-power capacity. Ten thousand horse-power has been reached by the Wisconsin producer.

Next in importance, probably will come the field of land reclamation. The San Joaquin and Sacramento valleys in California alone contain 10,000,000 acres of arid or semi-arid land. Under much of this land are both oil and water. Similar conditions obtain in the entire southern tier of states, from California east, including Texas. California is now the greater producer of low grade oil, and is the state where coal is most costly. In Louisiana and at coast points in Texas and California, drainage, as well as arid reclamation, demands cheaper power. The acreage of arid land upon which water can be carried by gravity is comparatively small. Water must be pumped to such land for irrigation purposes. Under old methods pumping became prohibitive because of the expense, even at a lift of thirty or forty feet. With oil producer gas, water may be raised 100 feet at the same cost as a thirty or forty-foot lift under the old method. Such a cost difference will add hundreds of thousands of acres to the land available for irrigation. Water is usually to be found under all arid lands, and the new method will make it available from depths heretofore utterly impracticable.

PRELIMINARY ESTIMATE OF PORTLAND CEMENT PRODUCTION IN 1911.

Complete statistics for the year 1911 were received by the United States Geological Survey during the month of January from about 70 per cent of the Portland cement manufacturers in the United States. Based on these returns an estimate has been made by Ernest F. Burchard of the United States Geological Survey of the entire output for the year. It is believed that this estimate is within 2 per cent of the exact quantity of Portland cement manufactured in 1911. There was apparently a slight increase in the production of 1911 over that of 1910, amounting to about 1,300,000 barrels, approximately 77,877,236 barrels having been made in 1911 as compared with 76,549,951 barrels in 1910. This represents an increase of only 1.7 per cent, as compared with the increase of 17.7 per cent that occurred in 1910 over the previous year. The figures for 1910 and 1911 are so close that when complete returns are received possibly a slight decrease in production may be shown. The average factory price per barrel not including packages was 86.7 cents in 1911, as compared with 89.1 cents in 1910, a decrease of 2.4 cents per barrel or 2.68 per cent.

WINNIPEG BUYS UNITED STATES CEMENT.

Winnipeg has contracted to buy 25,000 barrels of cement from the United States for delivery during 1912. Since the merging of all the cement interests of Canada under the head of the Canada Cement Co., says a consular report, it has been generally believed that this great corporation would absolutely control the sale of cement in the Dominion. The Lehigh Portland Cement Co., of Chicago and Allentown, Pa., was the lowest bidder at 71.43 cents per 100 pounds including sacks and 60 cents exclusive of sacks. The bid of the Canada Cement Co. was 72.65 cents per 100 pounds including sacks and 61.22 cents exclusive of sacks. The city will save $3,500 after paying a duty of 51¾ cents per barrel. In forwarding this bid the Lehigh Portland Cement Co. agreed that in case there is a reduction in duty or any revision in freight rates, the city will be given the benefit of the reduction.

GOVERNMENT IS USING "CEMENT GUN" FOR PLACING CONCRETE IN PUBLIC WORK.

The "cement gun," a device for putting concrete in place by compressed air, is being used by the quartermaster's department, United States army, in the Hawaiian Islands, and is proving of value in the construction of the ordnance shop at Fort Ruger. The apparatus was originally provided with a nozzle that became worn and clogged easily. These difficulties were overcome when Captain Edwards, quartermaster, invented a rubber-lined nozzle that gave complete satisfaction. The following description of the device as used in Hawaii is furnished by Captain A. B. Putnam, corps of engineers:

The cement gun is manufactured by a New York company, and consists of an air compressor, a four-cylinder marine gasoline engine of 20-horse power, a one-inch wire-wound rubber hose with walls three-eighths inch thick for delivering dry sand and cement to the nozzle of the gun and the gun or nozzle itself.

A mixture (one to two and a half) of cement and fine sand is delivered to the nozzle at 30 pounds pressure, and just before being discharged is met by a circular spray of water at 30 pounds pressure within the nozzle, so that the wet mortar is projected on the surface to be covered. The water supply is regulated at nozzle to obtain the correct consistency.

Triangular mesh is secured by staples to the studding of the structure, and is backed up by either heavy paper or wood placed so that the mesh will be in the center of a mass of stucco one and a quarter inches in thickness when the spraying is completed. In dwelling houses the stucco is placed on the studding inside as well as outside, but is made only about three-fourths inch thick inside. Smoothing is done by shooting a fine light spray of wet mortar. No finishing is done with the trowel. The finished surface inside is to be painted. The resulting stucco is very hard and makes a fair appearance, though it is necessarily rough. So far, provided the mesh is placed so that edges overlap, I have observed no cracking. It should be noted that this stucco is merely a thin wall of plaster, and bears no strain except that due to its own weight.

Tests are to be made by the Isthmian canal commission to determine the value of cement mortar applied to iron plates by the "cement gun," as a preservative of iron at Panama. Twelve plates 63.8x14 inches have been coated with a one to three mortar of cement and sand after they were cleaned to gray metal by the sand blast process. Six of these have been covered with a half inch coating, and the remaining six with a one-inch coat on one side and a one and a half inch coat on the other. Three plates of each kind have been sent to Balboa and three to Cristobal, where they will be kept immersed in salt water to test the mortar method of preventing corrosion. Two plates of each kind will be taken from the salt water bath at the end of three months, and one-half of the coating will be removed to determine the condition of the metal. The duration of the test for the balance of the plates will be determined later.

Reinforced Concrete Pipe Construction for Regina Sewer

By W. R. Harris

The City of Regina is situated on the Wascana Creek, Province of Saskatchewan, Canada, and has a population of 23,000. It has grown very rapidly, so rapidly, indeed, that in constructing a modern sewerage system it was necessary to build on a larger scale than is usually done.

One novel feature of this system is that it is paid for mainly by revenue derived from land owned by the city that was granted to it at the time it was chartered. About one-half million dollars will be spent for the construction of the complete sewerage system.

Wascana Creek is now polluted by the Regina sewage and the prevalence of typhoid fever may be accounted for by the fact that many dairymen water their cows from this stream. The operation of the proposed sewer system will eliminate this trouble.

The work now under construction is known as the Seventh avenue sewer, consisting of 10,761 feet 30 inch sanitary sewer, and 2,369 feet 66 inch and 8,392 feet 72 inch storm water sewer. At Campbell street the 72 inch storm water sewer makes an abrupt turn, emptying into Wascana creek, a distance of 3,240 feet above the sewage disposal plant now being constructed. At this turn a junction is formed between the 30 inch sanitary sewer and a 48 inch main running 3,248 feet to the sewage disposal plant. The proposed sewer is known as the Wascana Valley Trunk sewer and joins the 48 inch main above referred to by passing the 45 inch valley sewer under the 72 inch storm water sewer.

This is accomplished by a very ingenious type of construction, designed by John Marshall, a member of our society.

The Seventh avenue trunk sewer is being constructed with concrete pipe manufactured by the Lock Joint Pipe Co., under the Meriwether patents. This pipe is cast in sections in steel molds, and is reinforced with the triangular wire mesh sold by the American Steel and Wire Co. The joints are of the bell and spigot type, but do not project beyond the outside of pipe, and the pipe, when joined, appears as a monolithic tube of uniform thickness. When the pipes are joined the metal in the spigot end overlaps the metal in the bell end, and the mortar in the joint seals and locks the pipe.

Sealing is sually done by troweling mortar in the invert of the joint space up as far as the spring line of the arch, then after placing a spring steel sealing form, a thin mortar or grout is run into the remaining arch joint space by pouring through a hole, knocked in the bell at the top of the pipe. This hole is not broken in the bell until the pipe is placed in final position in the trench.

Design May Be Varied.

Now, speaking of the question of manufacture of this pipe, which will, probably, appeal to you, as contractors and engineers, more than other details, I will say that the design of the pipe is such that it can be varied, so far as reinforcement is concerned, to meet the requirements of any special job by increasing or decreasing the size of the reinforcement.

At the beginning of this work it was found that the aggregates had never been inspected or analyzed. We cast a few pipes, and noticing that the color was bad, we went into the question of the proportion of the aggregates and found that from one pit we got a poor sand, continuing 25 per cent of small gravel and 75 per cent of sand, including a large percentage of silt. We secured from another part of the country a cleaner sand, but the proportion of sand was greater than it should be.

I will give you the results of the tests made: The Lumsden sand, which we decided to use finally, contained probably 50 per cent of fine sand and 50 per cent of gravel. This sand, after screening, contained 36 to 38 per cent of voids, and the gravel 38 to 40 per cent of voids, while the bank sand and gravel had 29 to 30 per cent of voids. By using one part of Lumsden sand and two parts of Lumsden gravel we reduced the voids to 26.8 per cent, and we determined to screen sufficient gravel to obtain the proper aggregate, which we used with the residue, thereby increasing the gravel in the aggregate.

Another matter that gave us trouble is that the Canadian cement bag is much smaller than the American bag. An American contractor would consider that the sack contained approximately 9-10 of a cubic foot of cement, whereas it holds only 75-100 of a cubic foot, with the average a little higher on a series of tests.

It was after we made these tests that the city had other tests made, and as a result immediately issued orders for all work in town to stop until the matter could be looked into further. After that every contractor had to screen his sand to get better work. The sidewalk and building construction had been very poor, probably due to the fact that the contractors had not gone into the question of proper mixtures and proper materials. They may have been perfectly honest in their intentions to give a good job, but seldom gave it. It is in such things as this that our society can be of assistance to our members by letting them know that such things should be examined and looked into, and by recommending ways and means to avoid these troubles. No contractor wants to do bad work, and no one wants to have his money held up owing to faults resulting from the use of poorly graded materials or improper mixtures of concrete.

1:2:4 Mix Is Used.

This is getting away from the subject I began with, but it is to let you all know the troubles that we have had there.

Now, to return to pipe construction. We use ordinarily a 1:2:4 mixture of concrete, and after the concrete is made very wet, i. e., "sloppy," it is placed in the molds and churned, and cut by means of a hoe with a straight shank, the blade being curved to fit the circular forms. In that way we get a finished surface against the forms. After the concrete is placed in the molds the spigot end is made. The pipe is then allowed to stand in the mold 24 hours, and the casings stripped the following morning without removing or disturbing the pipe in any way. After three days we raise the pipe with a derrick and a lifting ring which we use. Each pipe is then set on its bilge, and allowed to remain thus for several days. The pipes are delivered at the place of manufacture, or at yards located along the line of the trench. At other times we have made the pipe alongside of the trench. In other words, the pipe is always delivered to the contractor on his work. The joints can be made immediately, and back-filling can be done at once, which is the plan adopted on the Regina contract.

At the beginning, sewer construction, i. e., the ex-

cavation of the trenches, was delayed, owing to the fact that the city was unable to get its steam shovel as soon as desired. The time of the arrival was so late in the season that the monolithic work or pouring of joints could not have been done. The pipe was laid with the thermometer down to six degrees below zero. Snow fell October 30, and when I left Canada, November 30, 1910, it was ten degrees below zero. Work was stopped on the day I left because of the breakdown of the steam shovel, not to be resumed until the spring of 1911.

The discussion which followed brought out other interesting information.

How Reinforcing Is Placed.

The total length of the pipe, including the bell, is 4 feet 3 inches, but each section of pipe laid gives a net length of 4 feet.

On this particular job reinforcement was placed within the inner third, viz, 1 inch on 30 inch pipe, and 1¾ inches on the 48 inch pipe from the inner surface. The 30 inch and 48 inch pipes have one ring of American Steel and Wire reinforcement style 34, and the 66 inch and 72 inch pipes have two rings of the same style of mesh, the inner ring being placed 2 inches from the interior surface and 1½ inches from the outer surface.

Reinforcement was held in place by means of an annular ring in the bell casting. We also have vertical spacing strips that hold the reinforcement the proper distance from the form. These strips are pulled as the concreting progresses, and when this reaches the top the strips are out altogether. The top ring is made so that it keeps the reinforcement in place until the concrete is set. After the sections of pipe are assembled the reinforcement is securely locked by mortar in the joint.

The lock joint pipe is reinforced for external pressure only, at the present time, and with a 1:2:4 mixture sufficient density is secured to prevent percolation of sewage through the walls or joints of the pipe. I made hydraulic tests of a 36 inch pipe with a 4 inch wall. I tested one pipe, and with a pressure of 7 pounds forced water through the ordinary concrete mixture of 1:2:4, although the percolation was slight. I grouted that pipe on the inside and the pressure increased to 14 pounds before percolation ensued. I used a waterproof compound mixed with the cement, but was not able to get over 14 pounds pressure without leakage through the concrete wall of the pipe. I used another compound mixed with the concrete and broke the pipe before I could force the water through the concrete. The pressure obtained was 32 pounds with a 36 in. pipe, in which the reinforcement was placed to resist external pressure, and not internal pressure, as I did not expect to secure such good results that a pressure of 32 pounds could not produce leakage. It was not necessary to waterproof all the pipe.

The maximum depth of the trench is 30 feet at Regina.

The pipe has a male and a female joint, so made that it forms a dove-tailed recess, and the concrete, even though there was no adhesion, would not fall out owing to the dovetail overlap.

Cement was purchased from the Canadian Cement Co. and was presumably Canada Lehigh, and the bags were branded "Canada cement."

Pipes were braced for the first few days, because the concrete was green and under the age of three or four days it is not advisable to have the green walls unsupported. We have perpendicular and horizontal braces in the pipe. Pipe are moved at three days old, before we take them to the yard, but we would prefer to have them three weeks old before we deliver them to the trench.

Joints may be made from the inside or in the manner described before, by knocking a hole in the upper part of the bell 4 inches or 5 inches in size, and the joints made by filling the invert with ordinary mortar, using a trowel and then pouring grout through bell opening at the top.

We oiled the faces of the steel forms in order to strip them off readily from the concrete, using what we call "form oil." It is manufactured by the Havemeyer Oil Company, and where we did not secure that oil we used a light paraffin oil.

Delivered to Job on Sleds.

The length of the pipe on this job was 4 feet, and the weight of a 30 inch 4 foot section is 1,536 pounds. For the 48 inch section the weight is 3,464 pounds; for the 66 inch section it is 6,172 pounds, and for the 72 inch section it is 7,240 pounds.

Most of the pipe was delivered after first snowfall, October 30, and we used sleds for that purpose. We made some bob sleds. The large pipe were rolled on to a bob sled. A rope was then fastened to the sled, which was drawn by a horse. The pipe were distributed along the trench, and all the contractor had to do was to pass his derrick hook through the pipe, lift it over the trench, lower it and put it in position.

To prevent the freezing of concrete, we used wooden flumes set alongside the pipe, and one flume over the pipe, making a V-shaped covering. We place in each pipe one or two gasoline lamps or torches, according to the expected temperature overnight, and between each two pipes we place another torch. We provide an opening so that there will be a circulation of air around the pipe, and had we placed the torch in one, the air would go around; but placing them between the two we were able to heat the air which went into the pipe as well as that which came out.

At first the forms were placed 3 feet apart; later in the season we placed them 6 feet apart. It was then we used the additional lamp. The forms were spaced sufficiently so that the lamps could be set between them while we were still assembling the other forms. The method of doing the work is as follows: To begin with, one row of pipes, made the previous day, is stripped of the forms, then as these forms are stripped they are assembled in another row. The reinforcement is now placed in a slot in each inside form, and sand is placed in that slot to prevent concrete flowing into it; then the outside casing is placed in position, after which the concreting is the next and last step of the day's work. We allow the reinforcement to lap 6 inches. The reinforcement is fastened at the lap by means of Sargent belt clamps, which are similar to the ring placed in a hog's nose. These clamps are then clinched with pliers, one being used on nearly every strand of wire. We set up the reinforcement on a mandrel and secure each strand at the lap, for the reason that we can thus assemble the wire mesh more quickly than where it is set up on the base of the form before it is wired together.

Labor Cost Varies.

Ordinarily, the lock-joint pipe can be manufactured for less cost and placed in the trench for less money than monolithic, due to the fact that most monolithic pipe is of heavier construction. Again, from the contractor's standpoint, there is rapidity of construction with the former as compared with the monolithic construction, which must be allowed to set before the trench can be back-filled. There are few weather conditions that prevent the laying of the reinforced pipe. The labor cost is practically constant in man-hours for lock-joint pipe, but not so in dollars and cents;

due to labor rates and the overhead expenses. Furthermore, it is never constant because of varying freight rates that influence the general expense. However, the man-hour cost per yard of concrete would be considerably less on the lock-joint pipe than on monolithic construction, because the concrete mixer can be placed closer to the pipes, unless it is placed above the trench and carried along with the work where the concrete is monolithic.

The contractor has nothing whatever to do with the manufacture of the pipe. We supply the sand, cement and the material. He buys this pipe as any other pipe, except that the breakage of clay pipe is usually at the risk of the contractor, as it is delivered f. o. b. cars. But not so with us. We have practically no breakage. We occasionally have a few bad pipe at the beginning of a job, where the materials are not what they should be. Sometimes there is too much sand. Originally the concrete specified was 1:4 or 1:5, and there was not sufficient cement to fill the voids, and we could not get a good concrete.

Ordinarily ¾ inch or 1 inch is the limit as to the size of stone. We use either gravel or crushed stone. For instance, on a pipe having a 7 inch wall, i. e., a 6 foot pipe, we could use a larger aggregate. There may be pipe ranging from 24 inches to 96 inches, and we specify a 1 inch aggregate. We get as good concrete with one as with the other.

In Regina we had forms to turn out 180 ft. per day, 100 feet of 30 inch and 80 feet of 48 inch forms. Ordinarily, a large job would be figured on the basis of 100 feet or more per day. If the contractor has to rush his work the size of the plant must be increased accordingly. We use wheelbarrows, shovels and standard tools, such as casing strippers; we have also an A-frame derrick, with a chain, blocks and trolleys of sufficient size to handle the pipe. Hoisting is done by hand power.

We make no bands, as they are not necessary in making our joints. We have used for our intakes, pipe as large as 84 inches in diameter without bands. Pipe now being made at Perth Amboy for a subaqueous intake is in 20 feet sections. It is to be laid in cradles on piles, and a diver connects the sections by means of cast iron flanges set in the concrete pipe and bolted together by a diver.

We make a wet mixture of concrete that can be easily puddled, more like a jelly than a soup.

Stands 20 Pounds Pressure.

As to waterproofing pipe of this style, and especially pipe having to sustain internal pressure, I think we could safely guarantee to make a pipe that will sustain 20 pounds pressure, but I do not think at the present that we could guarantee service for higher pressure. I believe that later we shall be able to make pipes that will resist a higher head. We can make our concrete as strong as we want by using heavier reinforcement; but we want to fill the pores of the concrete with something that will close them and not injure the concrete. By grouting the pipe I was able to go up to 20 pounds pressure.

I did not mention the waterproofing process used when I got 30 pounds pressure, as I am not sure the final results will be altogether right. In other words, I am not sure what effect the process has on the strength of the concrete. That is the main point. If we are using waterproofing that will cause the concrete to lose strength in course of time, we of course do not want it.

This pipe could be used for main conduits for water supplies but not for house service connection. There is another thing to consider in a pipe joint, .i e., the effect of placing the new mortar or joint compound against old concrete. If the shrinkage is only 1-1-000th of an inch, water will find its way through the crack at certain pressures. We do not know at the present time how tight we can make our joints. We are experimenting to make them water tight against high pressures.

For reinforcement we use a 4 inch mesh. The cross wires are spaced on 2 inch and 4 inch centers. and the longitudinal strands spaced on 4 inch centers.

Reinforced Concrete Railway Water Tank, Austinburg, Ohio.

RAILWAY WATER TANK OF CONCRETE.

Two years of service has proven the success of a 54,000-gallon water tank of concrete at Austinburg, Ohio. It was built by the Steel Concrete Construction Co., of Harrisville, Pa., with steel forms, has a tank 16 feet deep by 24 feet in diameter and is of concrete raised 32 feet above the track level. The walls are 8 inches thick at the bottom, tapering to 6 inches at the top.

No special means were used to make this work waterproof, except the use of a fairly rich mixture and a set of water-tight steel forms. The owners feel that their success in this and in many other similar tanks has been due to the use of the tight steel forms which retain in the concrete the water which carries the finest cement, holding this in the mass of the concrete, rather than allowing it to drain out through small openings in the wooden forms as ordinarily used. The contractors state that the costs of these tanks average twice that of wooden or steel tanks of equal elevation and capacity.

The only evidence of there being water stored within this tank is at one point where the newly poured concrete was slightly frozen during construction, which was carried on during November and December of a severe winter. Here a slight seepage occurred, which has stained the surface.

Concrete railway water tanks are comparatively new, but in a few years it is probable that reinforced concrete round houses, reinforced concrete water tanks and concrete posts for right-of-way fencing will become common. The railroads plan to use permanent construction methods rather than materials and methods good for a few years only and requiring continual painting and costly up-keep.

The Concrete Block as a Side Line for Tile Manufacturers

By James F. Hobart

Concrete block making may be profitably carried out by the tile manufacturer, but it should be kept most prominently in mind that the composition of the two—blocks and tile—are radically different and that the material and mixtures which give best results for one will not always answer for the other.

Concrete blocks and concrete sewer tile or pipe should be dense and non-absorbent as possible, while concrete drain tile should be strong, but as porous as possible.

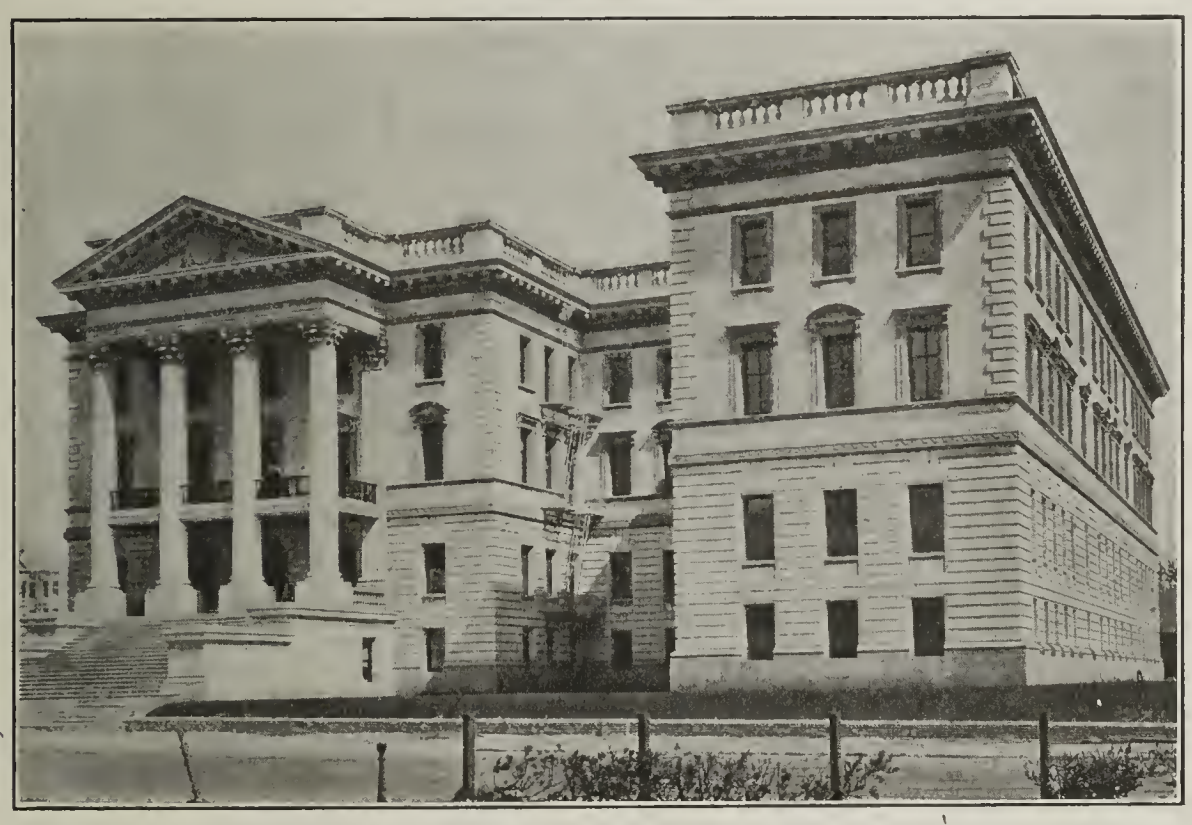
To produce as dense a concrete as possible, either for pipe or for blocks, the material must be composed of a mixture of coarse and fine particles. Not only of one size of coarse and another size of fine, but there must be a certain fixed quantity (within limits) of a number of sizes of material—in fact, the concrete material must be graded if the best results are to be obtained.

Consequently when great strength is desired, as in concrete block manufacturing, the porosity will be kept as low as possible by the selection and use of the several sizes and quantities of material which will yield concrete of the greatest strength, weight and with the least capacity for absorbing water or other liquids.

A wide range of tests has demonstrated to the entire satisfaction of the writer that by accurately combining screened or otherwise separated material in certain sizes and proportions that an almost impervious concrete can be made at will from ordinary gravel or broken stone. The gravel is preferable for the reason that it is easier to handle and compacts (tamps) much easier than concrete made from broken stone. The size of the particles of material has a good deal to do with the strength and weight of the resulting concrete blocks—that is, when blocks are made from the same kind of material, but of finer or coarser particles. Thus concrete made with large gravel and smaller sizes as required will be heavier, stronger and less absorptive than when made from the finer particles of material from the same gravel bank with the coarser particles left out.

The concrete block, having its thinnest parts at least two inches in thickness, can contain larger particles of aggregate than can be placed in the wall of a tile which may be less than one inch in thickness. In the concrete block pebbles less than three-quarters of an inch in diameter are all right, and as many such pebbles should be contained in the aggregate as can be worked into the block molds.

Theoretically, 23 per cent of three-quarter inch pebbles could be used to advantage in concrete containing that size of largest aggregate, but it would be hard to tamp such concrete into the comparatively thin spaces in the webs of concrete blocks, therefore practice modifies theory a little in order to secure easier handling of the green concrete. But nevertheless concrete made with 23 per cent of three-quarter inch pebbles and the requisite amount of the finer sizes will be stronger when tamped into large masses, like solid blocks, than can be obtained from any other proportion of concrete containing three-quarter inch material.



Southern Pacific Hospital, San Francisco, Cal. Medusa White Portland used as Stainless Cement for Mortar in Laying Sand Lime Brick.
D. J. Patterson, Architect.

When one-half inch material is the largest used, and this is better for blocks and for large tile, the greatest amount of one-half inch gravel called for by theory is about 30 per cent. But it must be stated that the concrete made with graded three-quarter inch material will be stronger and less porous than that made from one-half inch material, or from any size smaller than one-half inch. Therefore, to obtain the greatest strength and the least absorption, always use as much of the largest aggregate within theoretical limits as the size of the work will permit.

It is impossible to make as good concrete with sand as it is with gravel and sand, and the larger the aggregate, provided it is properly graded, the better in every way will be the resulting concrete. And, let me whis-

per it to you very confidentially, the larger the aggregate used the less cement will be required to obtain a stated strength per square inch. And it may be further stated—and proven—that fine material, properly graded, can be made into better concrete than larger but improperly graded material!

It doubtless has been noted by many that here and there certain factories are turning out better products than come from other factories even where the process of manufacture may be the same. And in some cases the processes followed are much more crude, yet the results obtained are far better than can be obtained in some other factories. Even by copying the same methods and by the expenditure of the greatest possible care, it is impossible to bring the product of a few factories up to a commercial standard.

The reason for the above, for both the good and the bad products, lies with the material used in the several factories. Where nature has furnished fairly well graded material the product is good, no matter how the concrete may be thrown together. But where the product is bad, no matter how much care and skill may be expended in its manufacture, it is almost a foregone conclusion that the material is naturally very poorly graded.

There is but one course open to the progressive block maker, to him who would make a uniformly good product all the time, no matter whether nature has lavishly provided the best of material or whether she has provided job lots of sand and gravel, that block maker must separate the material into its several sizes or grades and recombine them again in the percentages that will always make the best mixture for strength. By using this process the block maker is rendered independent of the condition of his raw material and is able to always turn out the same kind of concrete or to turn out any kind desired.

Methods have been worked out, and are in daily use, whereby run of bank material is separated into four or more sizes (grades) entirely without the use of screens, and at very slight expense. Material containing as much as 8 per cent of moisture may be readily handled by this apparatus, an amount of moisture which surely will put out of business any screen finer than No. 8 and even that number will make bad weather with 8 per cent of moisture in dirty material.

The grading of the raw material costs only about 15 to 20 cents per ton and the recombining of the percentages of the various grades, together with the cement and the proper amount of water, costs no more than the running of the material through an ordinary mixer. And the results are always uniform. Once set to the proper proportions, the machine will run on indefinitely, regardless of run of bank variations, always turning out the best possible mixture of aggregate from the material furnished to the apparatus.

So much for the preparation of the concrete and its mixing. The tamping should always be done by power whenever possible. A good tamper gives results which cannot be obtained by hand without the expenditure of a good deal of time. The pressing of concrete is not to be considered. It does not yield uniform density through the entire mass of the block. Properly graded material requires very much less tamping than a poorly graded mixture. The new method of jarring instead of tamping is deserving of being fully tested, but as yet the machinery is too costly and the process too slow—at least as far as the author has had a chance to investigate the matter—for the economical tamping of concrete. The several tampers in the market are very crude mechanically, but one or two of them are very much better than hand tamping and should be employed by all means in block making. It is strongly possible that the tamper of the future will be operated by compressed air. For large masses of concrete the pneumatic tamper is now largely employed.

The block maker, and the tile maker as well, should always cure the products of his factory by steam. Steam used at atmospheric pressure will cure concrete in 36 to 48 hours, and it will partially cure the product in 12 to 18 hours to a degree, which permits concrete products to be removed from the curing room and placed in yard storage to cure naturally until full strength is obtained.

But high pressure steam is the proper curing medium for the progressive block and tile maker. With steam at 150 pounds boiler pressure concrete can be cured in eight or nine hours from the time the steam is turned into the curing cylinder.

The concrete is not injured in the least by the high pressure curing process, but comes out fully developed in 28-day strength and ready to be placed at once in wall or trench. High pressure steam curing of concrete must not be considered as blowing high pressure steam against a pile of green concrete piled in a chamber or a room same as used for low pressure steam curing. Such a proceeding could only result in damage or destruction to the concrete. But when the concrete is enclosed in steam-tight cylinders, which look like huge boilers, then the high pressure steam remains fully saturated as it does at atmospheric pressure, the blocks are sopping wet all the time, and the curing process is natural, the only difference being that it is hastened by the combined heat and pressure of the confined steam.

Eight hours' exposure to steam at 150 pounds boiler pressure will cure concrete to as much or even greater strength than can be obtained by 28 days air-curing and sprinkling. It requires about one hour to bring the curing cylinder up to boiler pressure, thus making the process about nine hours long. The pressure may be blown off directly the eight hours steaming at full pressure has been completed, and the process of blowing off and removing the concrete from the cylinder will not require more than another hour, thus making the entire process about a ten-hour affair. It is thus easy to run a night turn and double the capacity of the curing apparatus. By curing daytimes and allowing the concrete to remain under pressure until it gradually dies away over night, the products may be dried out completely and come from the cylinder next morning as dry as if they were months old, and fully as hard. High pressure steam curing is the method of the future of curing concrete. It enables a factory to fill orders in 24 hours—something different from the two weeks at least now required. The same is true regarding tile, or any other concrete product, which can be enclosed in a curing cylinder of 74 inches in diameter.

The cost of making concrete blocks—and tile—by the grading and high-pressure curing systems need not be more than the cost of making such products in the ordinary way. The first cost of installation is, of course, greater with steam curing, but the labor bill may be cut in two by the use of machinery and it is the labor, outside of cement, which proves costly in block making.

By the use of an adequate grading system, the amount of cement can easily be cut.

As stated above, the great item of cost in cement products, aside from the cement, is the labor. And a great deal of this cost is incurred after the blocks or tile have been formed and detached from the molds. It costs a cent a block each and every time blocks are moved from one part of the factory to another. It is

in the handling of the finished product that the block and tile maker must look to an increase of profits.

Figure it as you may, in any and in every way, and tell me if you can move a lot of blocks from shop floor to storage at less than one cent a block. And, can you place them on board, either car or cart, at less than one cent each? Then, each and every time blocks —and tile, too—are shifted from one place to another, the expense is one cent each!

The present method, in most factories, is to off-bear the blocks and place them on the floor of the factory for 24 hours. That is operation No. 1, cost one cent. Next day, the blocks are turned over and the pallets removed, operation No. 2, cost one cent more. Next, the blocks are carried into the storage yard and piled while awaiting complete curing—and a customer—at the cost of a third cent. Lastly, the blocks are loaded upon wagons or into cars. This operation should cost another cent, but it usually costs two cents. The stock piles are so far from the shipping point that blocks cannot be carried from stock to car for one cent apiece, therefore they are loaded upon small cars or trucks at storage—another, the fourth, cent—and then handled again into the car or cart for the fifth, or last, cent.

And surely five cents a block for handling at yard and factory is enough to bankrupt any concern! But figure it for yourselves and see if you can perform the five operations above indicated upon any number of blocks at less average cost than one cent each per operation?

The remedy for this loss lies in high pressure steam curing. The blocks—and tile as well—are placed directly upon cars as fast as removed from the machines and the cars are pushed directly into the steam curing cylinders, where the products are immediately cured and then unloaded directly into car or cart for shipment or for immediate placing in the wall.

The entire cost of block handling is thus reduced to two cents per piece—once when the block is green, once when it is ready for the wall. It is possible to do this only by reducing the time of complete curing to the few hours called for by high pressure steam treatment. True, the same thing can be done by low pressure steam curing, but it costs a lot more to provide sufficient cars to accommodate two or three days' run of blocks. And, in addition, in time of rush orders the high pressure outfit can be readily worked day and night, double turn, and the output of the plant exactly doubled.

A high-pressure steam curing plant, with grading and mixing machinery, power tamping and a system of cars and tracks for handling the tamped products, and with a capacity of 600 concrete blocks per day of 10 hours, will cost about $20,000, including permanent concrete buildings and floors. The force of laborers required will be from six to eight, according to locality and the manner in which material and products are to be received and delivered.

Concrete plants, based upon the above-noted method of high-pressure steam curing, automatic tamping, grading and proportioning—all automatic and power operated and continuous—such a plant may be started for a very small amount of cash and added to as the business develops—that is, the grading and mixing machinery alone may be first installed under a temporary shed, the plan of the plant being such that the power tamping and steam curing may be added later without changing any portion of the original plant.

In fact, the writer installed such a plant last August, which is all fitted for high pressure steam curing and only requires the installation of the curing cylinders to make it a complete grading, proportioning, high-pressure, steam-curing concrete block plant. And this plant is equipped for manufacturing both blocks, tile and architectural stone up to six feet in length, the latter in a face-down machine similar to the better type of block machines.

And furthermore, the writer is ready to install other plants of similar character, and to guarantee, after examination of the material, a certain output and quality. But such guarantee will not be made without first making tests of the material to be handled.

Amherst Apartment, Amherst Place, St. Louis, Mo. Exterior Finish of Medusa White Portland Cement. Edw. E. Nolte, Architect. Yourtee & Hubbell, General Contractors.

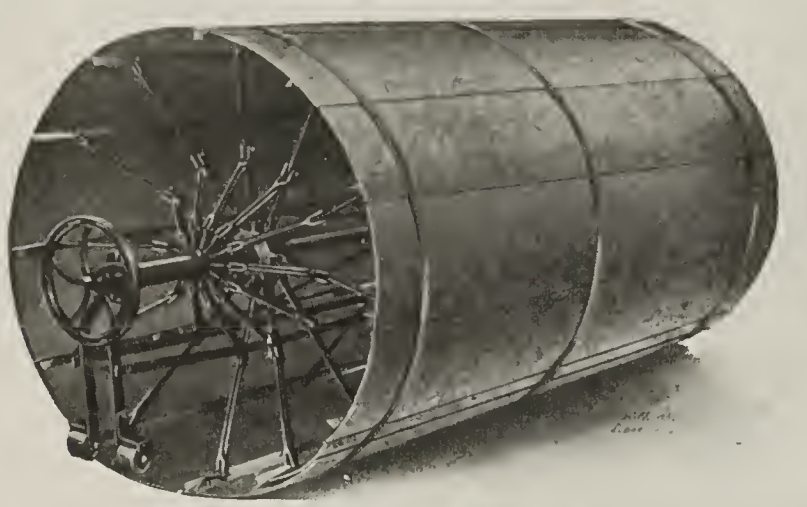
The Belknap Cement Products Co. of Greenville, Mich., will enlarge and improve their plant. New machinery will be purchased.

CONCRETE CULVERTS.

Everyone interested in good roads and good culverts is probably convinced of the decided superiority of concrete over other culvert materials.

The only excuse for putting in any culverts of such costly and temporary material as clay pipe, corrugated iron and wood has been the expense and trouble of making forms for concrete culverts.

At first, wooden forms were used, but they were unsatisfactory. The time, expense, labor and material used made the cost prohibitive and the work was rough and unattractive when completed. Then a steel form was manufactured which could be collapsed and removed after the concrete had set. This was a great improvement over wooden forms and better results were obtained. But the cost of the steel forms is considerable and they are open to this objection that a different form is needed for each size of culvert and as different sizes of culverts are necessary, a contractor, or township board, or whoever was building the culverts, would need so many different sizes that few could afford to buy the forms necessary to build even half a dozen sizes of culverts.



An Adjustable Culvert Core.

The Culvert Core Company offers a solution of the culvert question which removes all these difficulties. They make and sell at a comparatively low cost, an adjustable culvert core. It can be expanded to a diameter of 48 inches and is collapsible to a 20-inch diameter. It is instantly and automatically adjustable to any size within these limits and a culvert of any intervening size can be built over it. At any size it is braced, locked and round. It is supplied with trucks, so that it can be moved without lifting.

It has a range of 28 inches and is a ready-made form for every size of concrete culvert within its range and therefore only one form is needed where otherwise a different form is needed for every size.

These adjustable cores are in use all over the middle west and south and a unique little booklet of testimonials distributed by the company shows that they have given perfect satisfaction wherever used.

Some interesting information regarding the comparative cost and durability of different kinds of culverts and particularly concerning the building of concrete culverts is contained in their new catalogue, and concrete workers who have culvert work to do will do well to write Cement & Engineering News, 1117 Schiller Buildings, Chicago, for a copy.

A NEW MECHANICAL LUBRICATOR.

Features of a new model of mechanical lubricator designed for machinery requiring oil feeds under pressure, are set forth in Bulletin No. 194, issued by the Sterling Machine Company of Norwich, Conn. The bulletin discusses at some length the present day demands of lubrication and the fashion in which they are met by the lubricator in question. A photograph showing installation on a Corliss engine, and a drawing showing the lubricator in section, are presented, with explanatory treatment of methods of operation and means of dismantling for removal of parts. A brief description is given of check valve and oil feed indicator, with accompanying plates. A price list with other information useful to buyers is also included.

ATLAS CEMENT COMPANY'S NEW YORK CEMENT SHOW EXHIBIT.

One of the main centers of attention at the New York Cement Show was the exhibition by the Atlas Portland Cement Company of a large working model of the great Gatun Dam, Locks and Spillway at the Panama Canal. Perfect in every detail, it earned the unqualified approval of the army engineers and government officials when privately shown in Washington, prior to its display at New York.

Concrete Culverts.

The model is ten feet by five feet, and was placed at the corner of the Atlas booth, where the two main aisles intersected, so that no one who visited the show could escape seeing it—many in fact were attracted by the crowds that constantly thronged around.

Numbers of vessels are about to enter, or are passing through the locks; for example, an exact model of the Kaiser Wilhelm der Grosse is just entering, while the Cunard liner Caronia is at the crest of its rise in the center of the chamber. The Caronia rises and falls, with smoke pouring from her stacks, just as the real vessel would in passing through the gigantic locks, every detail being realistically produced.

Some idea of the magnitude of the Gatun work which the model represents can be gained from the fact that the dam will be almost one and a half miles long on its crest, nearly one-half mile at its base, about 400 feet wide at the surface of the Gatun Lake, which it will form, and 100 feet wide at the top.

The entire dam will contain approximately 21,000,000 cubic yards of material, and the Spillway section alone about 225,000 cubic yards of concrete.

Five million barrels of Atlas Portland Cement are being used exclusively in the entire Panama Canal, and the company should be congratulated on the clever way it attracted public attention to the fact at the New York Show.

The Alabama Waterproof Vault Co., Montgomery, Ala., was recently incorporated with a capital of $10,000, to manufacture concrete cemetery vaults.

Fundamentals in the Science of Waterproofing and Weather-proofing

By Edward M. Caffall

Paraffine wax as a means of making masonry, stone and concrete weatherproof was first utilized and developed by Robert M. Caffall. He was the first to perceive its properties and devise its practical application. The peculiarity of this substance is its remarkable inertness—it has no affinity for any other substance. Hence its name, derived from the Latin "parum" (too little) and "affinis" (affinity). It is composed of carbon and hydrogen in varying proportions, forming one of the very numerous hydro-carbons.

Mr. Caffall laid down the premise that in order to waterproof a building, the following problems must be considered:

1. The material must penetrate deeply.
2. The color and appearance of the building must not be changed.
3. The waterproofing must be permanent—i. e., last as long as the building itself.
4. It must not be too expensive. It must be the cheapest process in the end.
5. It must resist alkalis, acids, gases, water, sun, heat, frost and vegetable growth.

He found that paraffine wax answered all these requirements.

One of the numerous examples of work done by the caffall process is the Egyptian obelisk in Central Park, New York. It was treated twenty-five years ago (November, 1885). Up to the time it was treated about 750 pounds of stone had scaled off, but since the treatment the historic shaft has been immune from the action of the elements.

Earlier, but equally interesting examples of this kind of work are known. In 1868 a church window and gable end at Thedden Grange, Shalden, Hampshire, England, were treated, because of bad leaks in storms. This gable end, examined recently, presents a fresh, clean, sound appearance, while the rest of the stone is covered with lichen and rotting away. A hop-kiln at Alton Hants, England, treated the same year to keep dampness out of the kiln-dried hops, is still dry; moreover, water poured on the treated surface rolled off without being absorbed. Here are tests of forty-two years and no change apparent.

Equally striking are some examples of more recent work. The pillars of St. Bartholomew's Church, Forty-fourth street and Madison avenue, New York City, were procured from Italy some seven or eight years ago. The violet and green tones of this delicate marble give an effect to the building not to be matched in the city. But the weather so quickly attacked the stone that pieces began to flake off and the entire surfaces of the pillars became roughened and deeply pitted by decay. The writer undertook the renovation of the columns and their preservation by waterproofing. The result is astounding to those acquainted with the former conditions. By this means the architect has been justified in his selection of this stone for his color scheme, because it is now enduring as well as beautiful.

It has been estimated that the loss to buildings by weather and smoke damage in the United States amounts to no less than $500,000,000 annually. The loss caused by damage to marble monuments, many sculptured by eminent artists, can never be estimated. Statues of Washington and other great men, left unprotected, have been irretrievably ruined. Monuments are interesting to the public when original. Reproductions never satisfy. The first question asked by the average visitor to a cemetery is almost invariably: "Which is the oldest stone?" No matter how small or quaintly lettered, the chief interest centers around that early memento. Let the visitor to Trinity Churchyard, New York Ciy, compare the tombstone of Charlotte Temple with that of William Bradford, printer. The Temple stone is the original and arouses interest, while the Bradford stone replaces an original, and a feeling of regret and disappointment is inevitable. The worst example of this feature is to be seen in Windsor castle, England. The original Curfew tower, erected by William the Conqueror, was recently stripped of its outer stonework and a coating of new stone built all over. Not a particle of the original walls can now be seen. The visitor is looking, apparently, at a brand-new building. The effect is deplorable. Imagine the obelisk in Central Park dressed down and new hieroglyphics cut or thin slabs of stone built around it! The marble statue of Washington that stood in front of Independence Hall, Philadelphia, was lately taken away because of the fearful damage wrought by the elements. A bronze reproduction of modern manufacture has taken its place. Many years ago the authorities were warned of its condition and urged to preserve it, but the warning was unheeded 'till too late.

THE ATLANTIC & GULF CEMENT PLANT.

After being closed down for two months in order to connect up the new machinery which will more than double the output of their mill, the Atlantic & Gulf Portland Cement Company, Ragland, Alabama, resumed operations on February 1st. The following installations have been made: No. 5 Gates crusher, addition of two 42-inch Fuller mills on raw material, one 42-inch Fuller mill on coal, a complete blowing and coal injecting system for the kilns, one 9′x125′ kiln manufactured by Vulcan Iron Works, Wilkes Barre, Pa., pan conveyor for conveying clinker from kilns to clinker storage, a clinker storage with capacity of 75,000 barrels, gypsum and clinker weighing system, three Sturtevant Ring-Roll mills with Newaygo Separators, three Allis-Chalmers tube mills and a complete readjustment of transmission and conveying machinery.

It is said by competent engineers that this plant is now one of the best constructed in the country and capable of producing an exceptionally high grade product at a minimum cost. It is the intention of this company to further increase its daily production sometime during the present year.

Shope Concrete Products Company, 130 East Water street, Portland, Ore., report they are about to secure a new site for their works and put up a new plant in order to be able to care for their increasing trade. They will put in new machinery and manufacture, in addition to their face and mantel brick which they are now making, ornamental brick, terra-cotta and cast stone.

The Ideal Concrete Block Manufacturing Co., Peoria, Ill., incorporated with a capital of $5,000 to manufacture and sell concrete blocks.

SPECIAL PROBLEMS IN A BUTTERINE FACTORY.

The need of greater capacity and better facilities for handling their product caused the John F. Jelke Co., Chicago, manufacturers of butterine, to put up a new building better adapted to their needs. Perfect cleanliness demanded a thorough daily washing of all floors with hot water and at the same time the slightest leakage through the floors would be ruinous to the stored materials below. This required a special floor system consisting of the usual monolithic floors, cast integral with the concrete girders, beams and columns, a waterproofing layer of asphalt, and a wearing surface of three to five inches of concrete over the asphalt. This has added considerably to the dead load, but guarantees perfect watertightness and ideal working conditions for the making and storing of a food product.

Another innovation is the use of small cast iron squares, ½-inch thick, laid close together as a wearing surface for all truck runways. The illustration below shows clearly this method of eliminating wear. The present floors are laid not only with granite chips but also with these iron plates and promise to have as long life as the beam, girder and column system.

Butterine Warehouse and Factory of Reinforced Concrete.

The exterior of the building is of brick and cast concrete stone has been used to a limited extent in trim. In all 13,300 barrels of Universal Portland cement was used in this structure.

REINFORCING WOODEN POLES WITH CONCRETE.

The overhead department of the Indiana Union Traction Company, Anderson, Ind., this year is reinforcing about 1,600 of its trolley poles. Last year about 700 poles were reinforced and during the late fall of 1909 similar work was done on 250 to 300 poles. The method employed is, briefly, as follows:

An excavation to a depth of 24 inches to 28 inches is first made around the pole. The rot around its base is then shaved off and a thorough application of creosote is given the pole from the bottom up to a height of 3 feet or 4 feet above the ground. For installing the concrete reinforcement thirty-six forms, 48 inches long and ranging in diameter from 18 inches to 24 inches, are used. These are constructed of black sheet iron and are made in semi-circular halves. Semi-circular bands are riveted to the iron to hold the forms in shape, the edges of the forms being hinged together, thus permitting easy handling and assuring that halves of the same size are kept together. With thirty-six forms four men can be kept busy concreting.

A form of the size most nearly conforming to the size of the pole is laid around it, and inside this form is placed wire reinforcement consisting of 46 inches, twelve-bar heavy wire fence, with No. 7 top and bottom wires, No. 9 intermediate horizontal wires and No. 9 vertical wires spaced 3 inches apart. This fencing is cut in lengths sufficient to encircle the pole and be embedded in the concrete just inside the forms. The form is then filled with concrete consisting of one part cement to five parts gravel and sand. The top is sloped off slightly to assist in shedding water from the top of the concrete and around the pole. The form is removed from the pole after about twenty-four to thirty-six hours. After the forms have been removed the dirt is tamped in around the concrete and the pole is coated with a heavy paint or pitch compound around the top of the concrete to eliminate as nearly as possible the entrance of moisture between the concrete form and the pole.

The reinforcement is being applied to 30 feet and 40 feet poles, although the latter size poles are thought to be good for a considerable length of time. The 30-feet poles, however, are believed to be near the maximum limit of their life without some form of protection and therefore reinforcement, as described, has been applied.

G. H. Kelsey, superintendent of power, has charge of the work and devised the above method.

NORTHWESTERN STEEL & IRON WORKS.

The Northwestern Steel & Iron Works of Eau Claire, Wis., the largest manufacturers of single and double wall block machines whose products are well known all over the country and have been frequently described in our magazine sent us a number of catalogs and circulars on pressure block machines, tile machines, engines and concrete mixers.

There is hardly a tool or machine used in the manufacture of concrete that is not described in these catalogs.

TILE A PLEASING DECORATION FOR CONCRETE SURFACES.

The beauty and treatment of concrete surfaces have not received the important study warranted by the nature of the material. A few authorities advocate leaving concrete surfaces just as they are when the rough forms are removed. However, meritorious this may be, the majority of architects look upon concrete as a material which from its very nature gives a most extended opportunity in surface decoration and color. Architecture in stone is essentially dependent upon architectural lines—shade and shadow—whereas architecture in brick or concrete is dependent upon the actual treatment of their surfaces for their character and effect.

From this viewpoint, which is that of the majority of architects, any material enriching the surface of a concrete wall without interfering with its structural strength is possible and worthy of consideration. Of stone, brick, pigments and tile, the latter is, undoubtedly, best adaptable because of its beauty and extreme simplicity in application. In France, Italy and America the application of tile to concrete surfaces has been considerably exploited, so that many actual examples exist upon which to base an opinion as to the effect produced.

From these and from the general principles of design involved, it may be seen that extreme accuracy of tile setting, as we know the material in general use, is harmful to fine effects and not to be desired. Concrete, especially for exterior use, should be sufficiently rough and uneven to insure artistic surface modeling when seen from a considerable distance. This necessitates a free and varied treatment of any tile applied to it, both as to setting and as to coloring. The color of the concrete itself, in the main, determines the color scheme of such tiles as are applied to it. Rough and deeply colored tiles are found to blend most easily with the rough surface of the concrete, although it can easily be imagined how certain bands or spots in tile could be both highly colored and finished to bring out accents sought after by the designer.

Especially in country house work the application of tile must be concentrated largely because of the costliness of entirely covering the concrete. As a matter of effect, from an artist's point of view, what a concrete surface needs is contrast with some material which is more refined and decorative than itself. Panels, band courses or scattered designs in tiles, so long as they do not become all-over patterns, seem particularly advisable in this kind of work, as much depends upon concentrating this decoration as does an intelligent selection of colors and an artistic placing of the individual tiles. Without doubt there can be no limit to the ways in which tile employed in this way may be treated. Practically any size and shape, any color, any surface, are being manufactured continually, and along with this, molding and special colors and combinations may be obtained, provided the manufacturer considers the amount to be ordered as warranting him to produce special ideas in this way.

Vat Room Showing Runway, John F. Jelke Co.'s Building.

NEBRASKA CEMENT USERS' ASSOCIATION.

The Nebraska Cement Users' Association Friday elected the following officers for the year:

Peter Palmer of Oakland, president.

G. F. Lillie of North Bend, vice-president.

Frank Wipperman of Omaha, secretary and treasurer.

C. J. Tracy of Loup City, J. M. Kreiger of Rising City, and M. J. Peterson of Omaha, directors.

The convention was disappointed in the failure of Richard L. Humphreys of the national association to arrive and deliver an address. It was thought until almost the last moment that he might be able to be present.

Professor George E. Condra of the state university delivered a stereopticon illustrated lecture on the sand and gravel resources of Nebraska. He detailed the story of the sand deposits of the state as discovered by the university authorities in years of research work and pictured methods of taking it from its beds and putting it to work.

During the summer months the sand dredges along the Platte, he said are loading trains more than a mile long pretty nearly every day. The sand output of the state last year, he said, was more than $1,000,000.

PRODUCTION OF LIME IN 1910.

"The Production of Lime in 1910," by Ernest F. Burchard, has just been issued by the United States Geological Survey as an advance chapter from "Mineral Resources of the United States." The total production of lime in 1910, as reported to the Survey, was 3,481,780 short tons, valued at $13,894,962, compared with 3,484,974 short tons, valued at $13,846,072, in 1909. This represents a decrease in tonnage of 3,194 tons and an increase in value of $48,890. Owing partly to the inactivity of a number of small kilns operated by farmers to obtain lime for local use as a fertilizer, and partly to the abandonment of old and wornout kilns, there was apparently a large decrease in the number of producers reporting to the Survey.

Few mineral products have so wide a variety of uses as lime. Nearly half the lime manufactured in the United States is used as a structural material, and the remainder, amounting to about 1,750,000 tons, valued at about $5,500,000, is used for chemical purposes.

Lime is burned with a number of different fuels. Coal is used most extensively by plants in the United States at present, followed in order by wood, coke, producer gas, natural gas, and oil. A large variety of mixtures is also employed, such as coal and coke, coal and wood, coke and wood, coke and shavings, and shavings and manure.

It is probable, says Mr. Burchard, that if wood were universally abundant it would be more generally used than coal. Lime can generally be burned more slowly and at a lower temperature with wood than with other fuels. The lower the temperature at which lime is burned the better its quality will be.

On account of the rapid decrease in the wood supply there is considerable interest in the possibility of utilizing producer gas for burning lime. It is reported that under the most unfavorable conditions one kiln at St. Louis made 3½ pounds of lime to 1 pound of coal, using producer gas, as compared with an average of 2.4 pounds of lime to 1 pound of the same coal for coal-burned lime. The same manufacturer reports making as high as 4½ pounds of lime at times, and others have had as good success.

A copy of this report may be had free on application to the Director of the Geological Survey at Washington, D. C.

MARBLE LUMBER.

We believe that one of the most versatile men in the concrete products business is Amos Stouffer, superintendent of the Art Stone Co., 35 South Broad street, Waynesboro, Pa. Mr. Stouffer is getting along in years. He has spent two decades experimenting with concrete. He has worked out a number of formulas and has patented many processes for the manipulation and application of concrete in many small ways. He knows how to use glue molds, he manufactures a lawn roller mold and has a special process for making concrete blackboards.

One of his latest products is "marble lumber." By a process all his own he makes an artificial marble in solid colors or streaked to represent any known variety of natural marble. He sells his formulas to concrete products manufacturers and contractors who want to manufacture the products for sale or for their own use. His marble lumber may be made as soft as hard wood for interior finish, or harder than natural stone for outside trim. It may be sawed or nailed. Some of his thousand designs were on exhibit at the New York and Chicago Cement Shows. The marble is cast in inexpensive molds, to form material for mantels, fireplaces, show-cases, bath room fixtures, wainscoting, floors, etc. Several concrete plants operating under Mr. Stouffer's direction have created a good demand for marble table tops. There seems to be a wide range of use for marble lumber and its manufacture looks like an attractive side line for general concrete plants.

MAGNESITE PRODUCTION INCREASING.

The value of crude magnesite mined in 1910 ($74,658) is almost twice that of the production in 1909, according to Charles G. Yale in his report on magnesite issued by the United States Geological Survey as an advance chapter from "Mineral Resources of the United States" for 1910. While the production of the crude ore has materially increased, the rapid rise in value is due to the constantly growing demand for the calcined product. No crude ore is offered for sale, but after being calcined the output is used mainly in manufacturing paper from wood pulp; it is also used in making artificial stone, fireproof flooring and tiling, and in brick or plaster form for lining furnaces and covering steam pipes. The entire front of one large building in San Francisco was recently constructed of molded calcined magnesite in blocks and ornaments. The material was first calcined and then ground to a fine powder and was then made into a plastic cement and molded in the desired forms. The fine waste of the crude ore mined is now being utilized at California chicken ranches as a substitute for oyster shells and other substances fed to fowls for hardening the eggshells.

California the Only producer.

The only deposits of magnesite in the United States which have been commercially utilized are those situated in the valley and coast counties of California, and the entire output is consumed on the Pacific coast, the cost of transportation to points east of the Rocky Mountains being prohibitive. It is for this reason that large quantities of raw and calcined magnesite continue to be imported from Greece, Hungary and other countries, the imports increasing each year. It is the belief of Frank L. Hess, of the Geological Survey, who has made a study of the California deposits, that the opening of the Panama Canal will bring the California magnesite into successful competition in the entire United States with the imported product.

According to Mr. Yale's figures the imports of magnesia and magnesite, both calcined and crude, for 1910, amounted to 356,512,243 pounds, valued at $1,578,683, an increase of 121,072,377 pounds, with a value of $537,265 over the amount imported for 1909. A copy of the report on magnesite can be obtained on application to the Director of the Geological Survey, Washington, D. C.

CONCRETE ORNAMENTAL POSTS IN CALIFORNIA.

A new venture in municipal lighting is being made by Venice, Cal., with a concrete ornamental post, designed by City Engineer Lewis. The city will manufacture them to sell to property owners at cost and furnish light free of direct charge. Molds made to order have been procured by the city and all preparations for producing the standards in municipal yards are complete. The post itself will cost $9. The total expense of setting up the concrete post, equipping it with electric light and connecting with conduit is placed at $15 each.

SAND LIME BRICK CO.

The Worcester Sand Lime Brick Co., Worcester, Mass., was incorporated with a capital of $150,000. R. C. Cleveland, president; F. L. Powers, treasurer.

JEFFREY'S EXHIBIT.

One of the most interesting exhibits at the Chicago Cement Show was that of the Jeffrey Manufacturing Co., Columbus, O., in charge of F. H. Angell and three assistants. Their exhibit included a new type of vibrating screen, suitable for a wide range of material. It is all steel construction, simple and compact. The driving mechanism is such that blows causing vibration may be delivered on top or bottom, or alternately on top and bottom of the screen, which is a distinctive feature in the Jeffrey vibrating screen.

With ordinary materials, not more than 2 to 5 per cent of fines remains in the tailings. If the feed is not forced, even closer separation results. It is guaranteed to give large capacity and uniform product and is shipped on trial with privilege of returning if not satisfactory.

They also had on exhibit Jeffrey's latest design swing hammer pulverizer, for reducing limestone. This machine differs from any other make of hammer pulverizer. One feature is that it is equipped with ball bearings, something out of the ordinary on hammer pulverizers. Another important change or advancement is the method of adjusting the grate bars. The feeding device is also new and perfect.

AN UNUSUAL CONCRETE PLANT.

Charging a concrete mixed from freight cars on a siding is being done on the masonry work for the St. Clair avenue bridge of the Cleveland Short Line Railway by the use of small wooden hoppers supported on the sides of the cars and a narrow-gauge track parallel and close to the siding. The narrow gauge track is on an incline, continuously past all of the cars and up to a point above the mixer which is located at the end of the siding. A cable from a hoisting engine near the latter point is attached to a small steel charging car of the hopper type, with a dumping gate at one side. Its capacity is equal to one charge for the mixer. The hoppers hung on the sand and stone cars have bottom gates over the narrow-gauge track and are large enough for two men inside the cars to shovel into them continuously. The hopper for cement is supported on a light staging beside the point where a box car loaded with cement is placed. In the operation of the plant freight cars are placed on the siding with the cement car nearest the mixer, then a car of sand and a car of stone. A man in the cement car takes sacks of cement to the staging immediately in front of the door and dumps them in the hopper, one at a charge, while the shovelers in the gondola cars keep the side hoppers filled. The small charging car is allowed to run down by gravity to the stone car on the end, a man riding it to open the car-hopper gates. It is then drawn ahead by the cable, the rider tripping the gate latches as it is stopped at each hopper to receive its charge. It then proceeds to the mixer, where the rider opens the car gate and discharges the load.

CEMENT BLOCKS.

A committee has been appointed by the Indiana Cement Users' Association to confer with Building Inspector Winterrowd of Indianapolis, relative to drafting a new ordinance concerning the manufacture and use of cement blocks. The committee consists of H. E. Goodwin, O. L. Miller and George Bradshaw. Members of the association say it is impossible to comply with the present ordinance, which requires blocks shall be made of a one to six mixture, and stand a compression test of 1,000 pounds to the square inch when the blocks are thirty days old.

CEMENT MAKERS VICTORS.

Hal H. Smith, who represented the Michigan manufacturers in the investigation of cement freight rates made by the inter-state commerce commission, regards the recent decision of the commission a complete victory for the cement manufacturers.

The investigation covered the freight rates on cement shipped to Detroit from the mills of Michigan, Ohio and Indiana and when the commission took up the matter the railroads had just posted an advance in the rate from four to five cents per 100 pounds. The advance was ordered suspended until the hearing had been completed and the commission finally decided that the advance as a general proposition was not unreasonable provided the rates from eastern mills to Detroit were raised to prevent discrimination against Michigan, Ohio and Indiana mills.

This is exactly the point for which the complaints have contended through the protracted fight, says Mr. Smith. It mattered little to them whether their rates were raised or lowered within reason, but they were fighting for a readjustment of the rates in the east on the same basis as that maintaining in this district, that is, based on the same percentage of the sixth class rate.

Mr. Smith believes that the decision of the commission, though applying only to this particular district, will have an immense influence on the cement industry all over the country, while giving the manufacturers in this vicinity a new lease of life.

ASPHALT FLOORS.

"Asphalt Floors," the subject of a booklet published by the Standard Asphalt & Rubber Co., of Chicago, deals with the use of Sarco and points out the conditions under which it may be used to advantage as a flooring material. The asphalt floor has found favor in breweries where its waterproofing qualities have been considered desirable. The booklet devotes considerable space to the relative merits of asphalt, brick, concrete and composition floors for large buildings and prints a set of specifications for Sarco asphalt floors. For school, hospital and other floors not subjected to trucking a 1-in. thickness is sufficient but for warehouses and factories the asphalt layer should be 1½ in. This type of flooring, it is stated, has been used in factories, armories, freight houses, packing plants, railroad stations, etc.

WATSON DUMP WAGONS.

The Watson Wagon Company of Canastota, N. Y., is distributing a new catalogue of its dumping wagons; it is a 32-page illustrated booklet outlining the development of the dumping wagon and pointing out the special features of the Watson wagon on all sorts of contract work involving the moving of material. The company manufactures a wagon mounted on heavy coil springs and designed especially for handling hot asphalt and paving mixtures. There are also wagons for ashes and refuse.

CONCRETE GRAND STAND.

At Detroit, the Hunkey-Conkey Construction Company, Cleveland, Ohio, has taken a contract to erect a large baseball grand stand from plans prepared by the Osborn Engineering Company of Cleveland. This firm built the Cleveland base ball park, and the one in Detroit is to follow largely after it. The grandstands will be of reinforced concrete with pressed brick walls and will cost over a quarter of a million dollars.

USE OF COMPRESSED AIR.

The average conractor, as well as the owner of the concrete products plant, looks upon compressed air as a mysterious, expensive agent that is far beyond his reach—something he might be able to use to advantage if he could afford it and he knew how to apply it.

In no field of industry is compressed air of more importance than in the concrete business. The building contractor can use it to advantage in hoisting his materials and welding his rivets, the sand producer can make it pump sand for him, the drainage contractor can harness it and it will dig his ditches, the foundation contractor can drive piles with it and the concrete products manufacturer can tamp his blocks with its aid.

Thos. H. Dallett Co., Philadelphia, Pa. makes a full line of pneumatic tools and air compressors, and any of our readers who are engaged in any of the lines mentioned above can gain further information regarding the use of compressed air for their special purposes, by writing this company. The equipment is not expensive, when the saving in time and labor is considered. Portable compressors are furnished where it is necessary to transport the air plant, and one of the company's special lines is that of air plants for operating stone working tools and pneumatic tampers.

Portland cement companies that use drills in getting out lime rock should look into the Dallett compressors, which are also said to be dependable machines for all purposes of air compression around a cement plant.

Hanson Brothers, manufacturers of concrete building blocks and other designs, Deadwood, S. D., are erecting a new two-story factory to cost $7,500.

NEWS ITEMS.

Henry Gassaway Davis of Elkins, W. Va., democratic vice-presidential candidate in 1904, has been elected a director of the Alpha Portland Cement Company of Easton, Pa.

The annual stockholders meeting of the Ideal Cement Stone Company, Omaha, Neb., was held January 11 at the office of the company at 1708 Cuming street, at which time the following officers and directors were elected: N. J. Peterson, president and manager; P. J. Denison, vice-president; Charles Peterson, secretary; E. M. Carson, treasurer. These and J. A. Pearson were elected directors. Owing to the growing demand for first-class cement stone in Omaha and surrounding towns in Nebraska and Iowa it was decided to open an additional factory at Twenty-fifth and Oak streets, this plant principally to supply the south part of the city and South Omaha. This gives the Ideal Cement Stone company three large factories, all equipped with the most modern steam curing and up-to-date power machinery, enabling them to furnish the best cement stone at lower cost.

Hon. R. L. Borden has received a series of resolutions from Winnipeg board of trade demanding an inquiry into the Canadian cement merger. The prime minister has replied that the matter will be given his serious consideration.

The Iowa Portland Cement company of Des Moines has announced the resignation of J. C. Burch, who has been general manager, secretary and treasurer of the company ever since its organization. C. B. Condon, general sales agent for the company will succeed Mr. Burch and take up his duties in that capacity on January 1st. Prior to his residence in Des Moines, Mr. Burch was secretary of the United States Gypsum company with headquarters in Chicago.

HARPER MEMORIAL LIBRARY
University of Chicago. Basement Waterproofed with Ceresit.

Some Architects and Engineers Think Waterproofing Concrete Is an Extravagance!

We claim that every job of concrete construction where the concrete is exposed to water penetration should be thoroughly waterproofed. Ordinary concrete is so porous that water will penetrate it. In freezing weather this water freezes and swells the mass; cracking it in spots and weakening its strength as a structural material. Repairing such weakness is often impossible. It is therefore of vital importance that the concrete be protected from these conditions by a thorough waterproofing while the structure is in course of building.

NO KNOWN METHOD OF WATERPROOFING CONCRETE IS MORE EFFECTIVE THAN TO CERESITIZE THE CONCRETE BEFORE IT GOES INTO THE MOLD.	NO SYSTEM OR METHOD OF TREATMENT IS SO INEXPENSIVE AS THE CERESIT METHOD WHEN EFFECTIVENESSS IS CONSIDERED.

"Ceresit" Waterproofing

is an integral waterproofing that is incorporated in the whole concrete mass, permeating every part of the concrete and rendering it uniformly and permanently waterproof and damp-proof and protecting it from disintegration by freezing. *Ceresit* is a cream white paste which is put into the water intended to be used in mixing the cement, sand and stone. The *Ceresit* being held in suspension in the water is distributed uniformly throughout the mass during the mixing process.

It adds density to the concrete and does not affect its tensile strength, nor does *Ceresit* alter the color of the concrete work.

Ceresit has been successfully used by leading engineers on all sorts of work requiring moisture resisting concrete. It has been used on tunnels, aqueducts, viaducts, sewers, foundations, building walls, retaining walls, dams, reservoirs, swimming pools, water tanks, water towers, cellars, basements, floors, boiler pits, roofs and in every other conceivable way that requires a waterproof concrete.

Ceresitized cement mortar is an effective, permanent water repellant when used as a coating on all kinds of structures built of concrete, brick, stone or tile, and on buildings whose outside coating is stucco or cement plaster.

Our Guarantee—We will put up a bond that *Ceresit* will waterproof any kind of a concrete cement mortar job in a satisfactory manner, when done under our direction.

CERESIT IS CATALOGUED IN "SWEET'S" INDEX

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PLEASE CUT OUT THIS
REMINDER
to write for Free Book "Q" on How to Effectively and Permanently Waterproof Concrete and Cement Mortar.
Ceresit Waterproofing Co.
Clark and Adams Sts., Chicago (16)

The plant of the Altoona Portland Cement company has been closed down, probably awaiting the consummation of the great cement plant merger.

Hiram Norcross, Kansas City, an attorney connected with the contemplated cement merger, said last night that nothing has been accomplished toward uniting Western cement manufacturers. Because of the legal difficulties encountered in the Sherman Anti-Trust law, it is possible that the consolidation may fall through.

A reinforced concrete grand stand built in Cincinnati in 1901 has outlived its usefulness. It is now being demolished by the aid of a derrick and a 3,000 pound pile-driving hammer. In spite of the general impression that wrecking of reinforced concrete building is almost impossible, this job has been carried on with dispatch. After the slabs and beams were wrecked the steel was cut by an oxygen acetylene flame, making easy the removal of the various members as they were cut loose. The steel, of course, was found to be in perfect condition, the cement having prevented any corrosion, and an examination of this work demonstrates conclusively the lasting qualities of well-built reinforced concrete structures. The new stand will be similar in material and general design and will be one of the largest in the National League circuit.

Artificial limestone blocks made from a grout consisting of one part cement, two parts marble dust and lime stone, graded from ⅛ to ½ inch, are being used for the exterior walls of a reinforced concrete hospital at Coney Island, New York. The blocks are cast in a wet sand mold from patterns of wood of the exact shape and size of the desired blocks. After hardening four days in the molds, and curing in the open air under dampened canvas, they were cleaned and finally finished on a rubbing bed. The use of blocks of this nature should greatly increase the use of concrete for the better class of buildings, as there is no question of their suitability for the highest class of architectural effects.

Following one of the quietest years in the history of the cement industry, the Colorado Portland Cement company has announced the closing of its big plant at Portland next week for a period of three months. This announcement does not come as a surprise to those who have kept in close touch with other cement plants in the United States. The Portland company at the present time has a total of 135,000 barrels of cement and clinkers on hand, which, with a small production from time to time, will supply the business in sight from now until April 1. At least 100 men will be given employment part of the time during the shut-down, making improvements about the plant and quarry.

This means a payroll of $5,000 per month and somewhat relieves the situation for the older employes and gives them an opportunity to earn something during the winter.

FARMERS BUILDING CONCRETE SILOS.

The Minnesota Cement Construction Company, makers of the Playfind cement silos, has purchased the patent right for fifty-two northern counties. It will maintain its head office at Long Prairie, Minn. The company has also started to manufacture the stores for the silos at Detroit, Minn., and a big business is expected. Silos and dairying in northern Minnesota have come to stay.

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The Most Economical Sprocket Wheels on the Market

Last several times as long as ordinary cast-iron wheels, and cost but little more

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Life of chain prolonged, because wheels are not rapidly wearing away from the proper pitch diameter

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The economy resulting from the use of these wheels appeals to all who appreciate durability and satisfactory service, and especially to those who wear out machinery rapidly in handling Raw Materials in Cement Mills, Phosphates, Crushed Stone, Ashes and other abrasive materials

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OLYMPIC PORTLAND CEMENT COMPANY.

The Olympic Portland Cement Company, in which Balfour, Guthrie & Company are heavily interested, and which is erecting a plant a short distance west of Bellingham, Wash., on the Great Northern Railway, under the direction of James C. Muir, has established its main office in the Sunset block, Bellingham, under the management of R. Richards, for some years back connected with the Portland cement industry of eastern Canada.

The plant being built is, for the most part, after the designs by F. L. Smidth & Company, New York, The wet process is to be employed. The wet and dry grinding ends of the mill are in duplicate and consist of Smidth's No. 85 Kominuters, and No. 18 tube mills. The kilns will be 9 feet in diameter and 170 feet long; they will contain a burning zone 40 feet long by 10 feet in diameter and will be the first application of the feature in any American plant.

The plant will be equipped to burn either oil or coal and will be individual motor driven.

Construction work began October 1, 1911, and the firm contemplates having cement ready for the 1913 market. The buildings will all be of concrete and steel.

CLOSED FOR THE WINTER.

The Western States Portland Cement plant at Independence, Kans., has decided to shut down for the winter. The reason given is the low prices and large supply on hand. According to press reports the Sandusky cement plant at Syracuse, Ind., has closed down for the winter, throwing several hundred men out of work. The Edison Portland Cement plant at New Village, N. J., have closed down on Dec. 1, until further notice.

STUCCO WORK IN THE EAST.

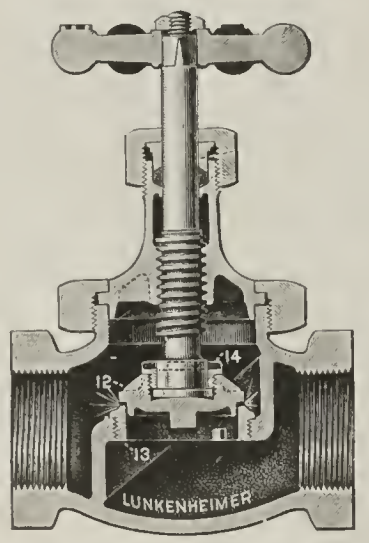
Many concrete men who attended the New York cement show last December remarked upon the number of stucco houses built and in course of construction in New York and vicinity. In many New Jersey towns a large percentage of the new houses erected for from $2,000 to $10,000 are of stucco.

The architects have taken a great interest in stucco work in the East and many fine examples of this class of construction are illustrated in a booklet issued by the Monument Plaster Co., 2 Essex St., Harrison, N. J. These houses are in most cases built of wood frame to which has been applied expanded metal or woven wire lath. The finish consists of "Oriental" stucco, a prepared stucco manufactured by the company issuing the booklet. This material is slow setting and many contractors praise it because of the ease with which it is applied and the absence of marks when joinings and patches are made.

Another fine collection of stucco houses was recently illustrated in American Homes and Gardens. These houses were built at Long Beach, Long Island. "Sykes" expanded metal lath was used.

RETURNED EMPTY CEMENT SACKS.

It is a pleasure to announce that the movement on the part of the Western Classification Railroads to increase the freight rates on returned empty cement sacks and other carriers, has been defeated, and that no increase over the present rates will be made at this time, writes Gordon Wilson, chairman sack committee, Association of American Portland Cement Manufacturers.



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With the New Jeffrey Vibrating Screen

With ordinary materials not more than 2% to 5% of fines remains in the tailings. If the feed is not forced, even closer separation results. This machine has an adjustable screening frame, suitable for a wide range of materials. Send your samples to us for test.

Write for complete information regarding this machine.

JEFFREY MFG. CO. Columbus, O.

CEMENT DRAIN TILE.

While some sections of the country are clamoring for water for their parched and dry land, others are praying for relief from too much water. If it were possible to mix the soil, seasons and climate of the dry portions of Oregon and Washington with the swamp lands of Mississippi and Louisiana, the result would probably be an ideal condition for farming purposes.

But it is not alone the very dry countries that want water, nor the very wet that would get rid of it. Much of the finest soil in the United States suffers for want of proper drainage at certain seasons of the year. Books have been written on the subject, fortunes spent to reclaim acres of land by drainage.

The underlying requirement of drainage is "tile," and permanent results are obtainable only by permanent drain tile.

For many years the agriculturist has depended upon burned clay tile for his supplies, and it is only in recent years that it has been possible to find a substitute at a reasonable price, in fact, one which every cement worker could make without a large outlay for equipment, buildings, storehouses, etc.

With the advent of cement products, at reasonable prices, efforts were made to perfect a machine by which cement drain pipes could be made in quantities and at low cost. A cylindrical form and casing would do the work, possibly, but at an enormous loss of time and material.

The W. E. Dunn Co., 4139 Fillmore street, Chicago, Ill., recognizing the need for a practical machine of this character and being well versed in the manufacture of machines for making cement blocks, cement brick and cement porch columns, have placed on the market a machine for making cement drain tiles, which they claim eliminates much of the inconvenience usually attending work of this character. So certain are they that it will meet every requirement, that we understand they offer to send it on fifteen days' free trial. So many other good points are claimed that we ask every interested reader to get their catalogue and see for himself. The machine as shown in their advertisement in this issue will give a good idea, but if one has use for it, the real machine will be shipped on approval. It takes faith in one's machine to send one out under such conditions, but we believe the W. E. Dunn Co. have the goods. Mention Cement & Engineering News when writing them.

NATIONAL ASSOCIATION OF CEMENT USERS.

The 1912 meeting of the National Association of Cement Users will occur in Kansas City coincident with the Kansas City Cement Show, March 14th to 21st. The leading men of the industry, engineers, architects, contractors, concrete specialists and artisans consider such membership worth many times the small annual dues of $5.00. The membership has grown till it is now 1,100, all active men. The volumes of the proceedings of the Association contain information of great value concerning the proper use of concrete. They are replete with the actual experiences of the leading experts of the country. The purpose of the Association is to assist users of cement to obtain better results and thereby more business. Copies of their proceedings may be bought at $5.00 by non-members by application to the secretary. Mr. Edw. E. Krauss, Harrison building, Philadelphia, Pa.

Charles D. Fowler just completed a new concrete products factory in Maryland Park, Washington, D. C., to cost $20,000.

Wholesale Prices On Concrete Machinery

Tell us what you are interested in and we will send catalog of wholesale prices. Any or all catalogs sent free. Write today.

Block Machines, $10 to $250; Brick Machines, $22 to $75; Mixers, $24 to $1,000; Porch Column and Baluster Outfits, $15 to $75; Cap and Sill Moulds, $12 to $35; Lawn Vases, $15 to $25; Ball Moulds, $2 to $17; Grave Stone Moulds, $7 to $69; Well Curbing Moulds, $4 to $7; Drain and Sewer Tile Moulds, $6 to $83; Block Cars, $11 to $17; Fence Post Moulds, $7 to 12; Silo Moulds, $14 to $150; Coping Moulds, $18; Hitching Post Moulds, $20; Baluster Moulds, $6 to $18; Jardinieres, $12; Special Gate Post Moulds, $10 to $30; Newell Post Moulds, $14; Grave Markers, $7; Burial Vaults, $90; also complete line of Cinder Crushers, Rock Crushers, Sand and Gravel Elevators, Sand Screens, in both Revolving and Stationary Type, Mortar Gauges, Wheelbarrows, Jointers, Groovers, Edgers, Corner Tools, Curb and Guttter Tools, Corrugating and Radius Tools, Roller Jointers, Brick Tongs, Curb Clamps, Curbing Edgers, Hawks, Floats, Line and Indentatiou Rollers, Tampers, Rammers, Name Stamps and Indentation Letters, Wall Plugs, Expanded Metal and Water Proofing, Flower Pots, etc.

Wholesale Prices on everything needed for concrete work

Northwestern prices save you from 15% to 50% on any machinery, moulds, tools, appliances and accessories used in concrete work. We are the largest manufacturers of concrete machinery in the world. We add no profit because of patents, or territorial rights, and our big volume of business enables distribution direct to the user at wholesale prices. All machines guaranteed and returnable at our expense, inside of ten days if not satisfactory. Big stock for immediate shipment. We also build machinery for other concrete machinery concerns, and are especially equipped for big contracts.

Northwestern Concrete Machinery and Tools

Our Cone Batch Mixer sells at about a third the price of any other standard mixer; will reduce labor costs about one-third. Less than waist high intake makes quick charging. Special discharging device releases any amount of mix from shovelful to cartload, shooting it directly into wheelbarrow or moulds—no slopping—all sizes from 7 ft. up.

Get Our New Mixer Catalogue

Illustrates superior features and construction of Northwestern Mixers—the largest line in existence—a mixer for every purpose at wholesale prices—sidewalk contractor's, block plant, continuous mixers, etc., hand gasoline, steam, electric power, combined hand and power mixers, etc.

The Best Mixer Ever Made

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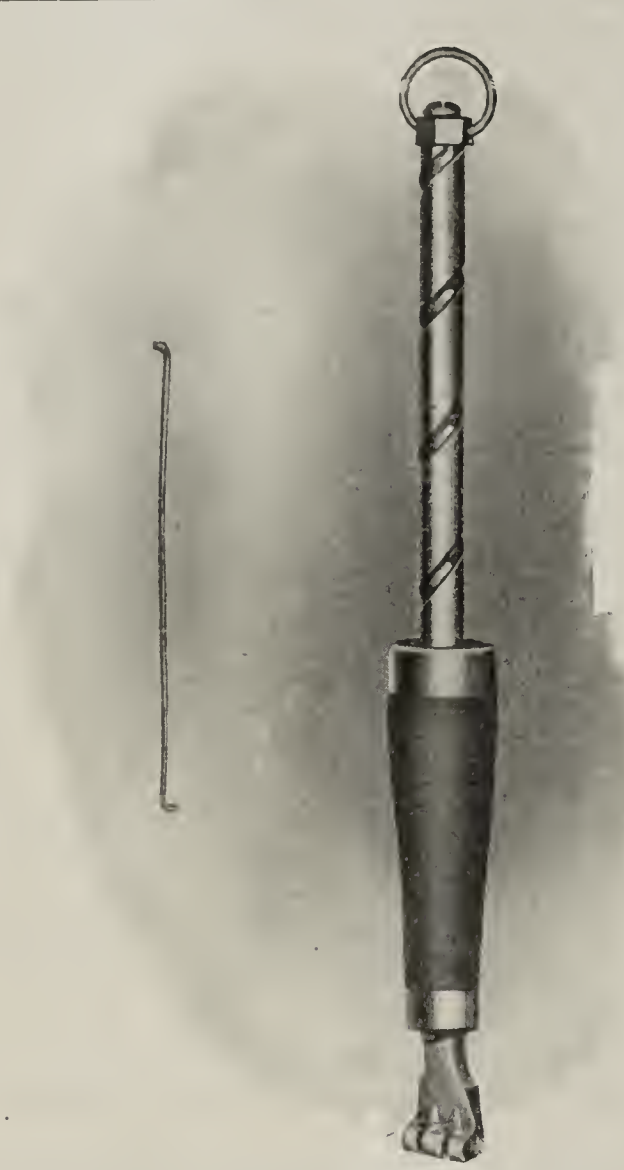

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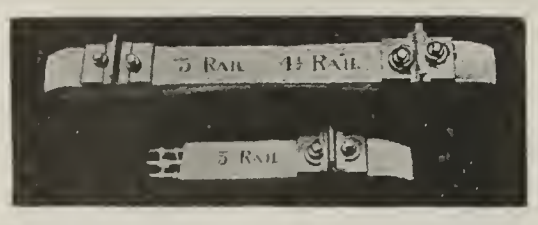

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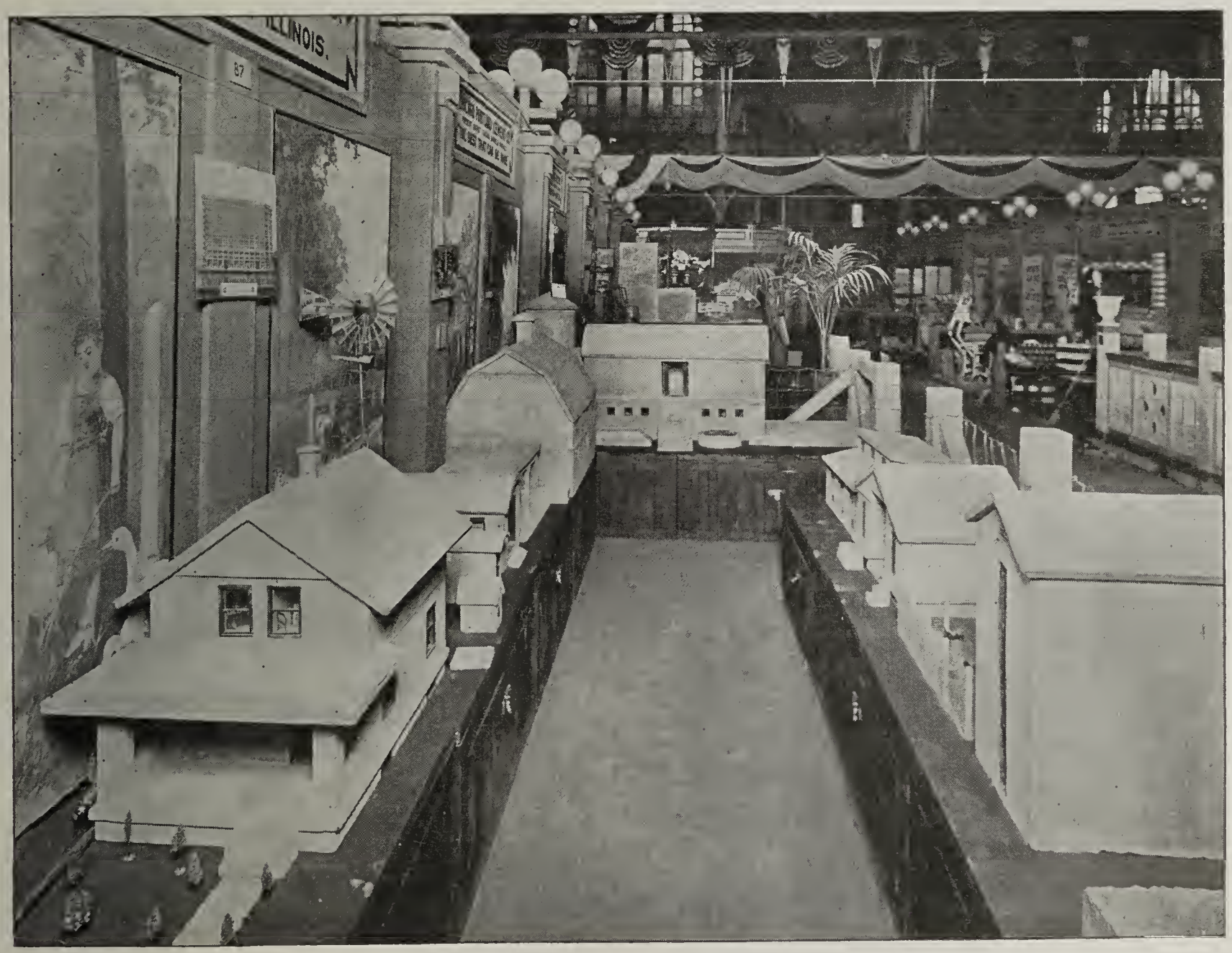

ALL CONCRETE MODELS OF FARM BUILDINGS.
Exhibit of Chicago Portland Cement Company at Coliseum, Chicago. (See Page 98.)

CEMENT AND ENGINEERING NEWS

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CHICAGO, APRIL, 1912

ALL CONCRETE MODELS OF FARM BUILDINGS.

The cement shows held annually in various parts of the country have been responsible for many interesting displays illustrating the general utility of concrete as a building material. Concrete brick and blocks, for example, frequently seen at these events, astonish the visitor who is unacquainted with the progress this particular phase of the use of cement has made in recent years. The exhibits of the mold manufacturers are always a source of great attraction, likewise the machinery and equipment designed for the mixing, molding and application of concrete. But that which seems to appeal particularly to the visitor is the exhibits pertaining to the use of cement about the home and on the farm. Such exhibits create greater general interest for the reason that a large proportion of the visitors either rent or own "a place" in the country. The extreme difficulty of building a practical exhibit of this nature is apparent to every user of concrete. Lumber and plaster of paris models with the aid of photographs of concrete work actually done on the farm have heretofore served the purpose to a certain extent, but such exhibits lacked originality and either brought into use a material largely replaced by concrete on the farm today, or one that is more or less unknown to the farmer.

This condition existed until the recent Chicago cement show at which event the Chicago Portland Cement Company appropriately installed an exhibit consisting of no less than 30 all-concrete models of farm buildings and miscellaneous structures on the farm, photograph of which is herein reproduced. The visitor who inspected this exhibit was quick to grasp the wonderful utility of cement on the farm. It was an original, convincing display.

The architectural and fireproof advantages, the low cost of maintenance, the strength and durability of construction, and the sanitary qualities obtained by the use of concrete were combined in this display and were at once apparent to the visitor. *Located on the main aisle of the Coliseum building this exhibit occupied approximately 400 square feet.* The idea was to exhibit only such concrete work as could be successfully accomplished on the farm, and to demonstrate it in the simplest manner possible. Wall construction was shown by a reinforced concrete wall of plain design, 4 feet high, which enclosed part of the exhibit, a space 12 x 10 feet. Concrete urns cast from an ordinary metal wash basin, such as is found in every farm home were placed at intervals along the top of the wall, while a metal cuspidor served as the mold for the base of these urns. The use of concrete blocks was shown in a wall 3½ feet high which intersected the exhibit, while the widely discussed concrete furniture, comprising 2 tables, 4 chairs, 1 bench and 2 small milking stools were also exhibited at this booth.

The space devoted to the display of the models fronted 24 feet on the main aisle and was 10 feet deep, surrounded by concrete posts and American steel and wire fencing.

The German idea as to the location of the various buildings was followed as nearly as conditions would permit, each of them being in proximity one to another so as to be easily accessible during bad weather without venturing too far from the residence.

All of the models were built to the scale of one inch to the foot, the residence as shown in the picture being 22 inches wide, 36 inches deep and 28 inches high. It is a two-story seven room structure, was decorated interiorly, completely furnished, equipped with a telephone and other modern farm conveniences, and electrically illuminated throughout. Fronting the house was a long stretch of concrete roadway, concrete curb, sidewalk, stepping block, hitching post, and on the lawn was a concrete roller. To the rear of the residence was located the following models, all in concrete, in the order named: cistern, well house and windmill, dog house, smoke house, ice house, garage, carriage and wagon shed, horse and hay barn with watering trough adjoining, dairy, cow barn, with silo and elevated water tank, circular watering trough and machinery base adjoining, the concrete approach to the second story of the barn being utilized as a root cellar, a concrete feeding floor with manure pit extending between the cow barn and the hog house, corn crib and granary, and lastly a chicken house. The miscellaneous models included concrete steps, drain tile and culvert.

In addition to the foregoing the volume of "Chicago Double A" Portland Cement, torpedo sand and crushed limestone necessary for one cubic foot of concrete mixed in the proportion of 1-2-4 was also shown, together with the tools and equipment, in miniature, used in proportioning the mixture and in the mixing and placing of concrete, consisting of a measuring box, mixing board, shovel, water barrel, hoe, wheelbarrow, tamper, trowel and straight edge. The concrete used in building the models was mixed in the proportion of one part "Chicago AA" Portland Cement to one part Torpedo Sand, and the reinforcement varied from extremely fine wire mesh in some models to ¼ round steel bars in others.

The exhibit is now installed in the Record building, U. S. Stock Yards, Chicago, where it will remain on exhibition until the State Fair season opens up, several officials of the various state boards of agriculture in the middle west having seen it and expressed a desire to have on display at the various events this fall.

Mr. Frank A. Caldwell, concrete contractor, 4723 Halsted street, Chicago, built the entire exhibit, and is certainly to be congratulated on the work.

The Electrical Precipitation of Suspended Particles

By F. G. Cottrell*

The removal of suspended particles from gases, by the aid of electric discharges is by no means a new idea. As early as 1824 we find it suggested by Hohlfeld as a means of suppressing ordinary smoke, and again a quarter of a century later by Guitard. These suggestions, which do not seem to have stimulated any practical study of the question, were soon entirely forgotten and only brought to light again by Sir Oliver Lodge many years after he himself had independently rediscovered the same phenomena and brought them to public attention in a lecture before the Liverpool Section of the Society of Chemical Industry Nov. 3, 1886. The first recorded attempt to apply these principles commercially appears to have been made at the Dee Bank Lead Works. The general principle of electrical precipitation of suspended matter was at this time patented by Alfred O. Walker of the above firm in several countries, but these patents have long since expired. The apparatus was installed in 1885 by the works manager, W. M. Hutchings, with the coöperation of Prof. Lodge and briefly described by the former just before its completion as consisting of a system of metallic points situated in the flue from the lead furnaces and excited from two Wimshurst influence machines with glass plates 5 ft. in diameter, each machine being driven by a one-horse power steam engine.

The apparatus undoubtedly did not in practice fulfil expectations as we find nothing further of it in the literature. The most apparent weakness of the project lay perhaps in the reliance on the Wimshurst machine, which had then just been brought out and from which a great deal more was anticipated than has been justified by experience, at least as far as commercial applications are concerned.

Fig. 1.

Since that time an occasional patent or article has served to keep the subject in the public eye and in 1903 Lodge himself took out a patent covering the use of the then new mercury arc for rectifying high potential alternating currents for this purpose.

Up to the present time none of these patents seem to have been carried into successful commercial operation on the large scale in the chemical or metallurgical industries.

Some four years ago while studying various methods for the removal of acid mists in the contact sulfuric acid process, the author had occasion to repeat the early experiments of Lodge and became convinced of the possibility of developing them into commercial realities. The

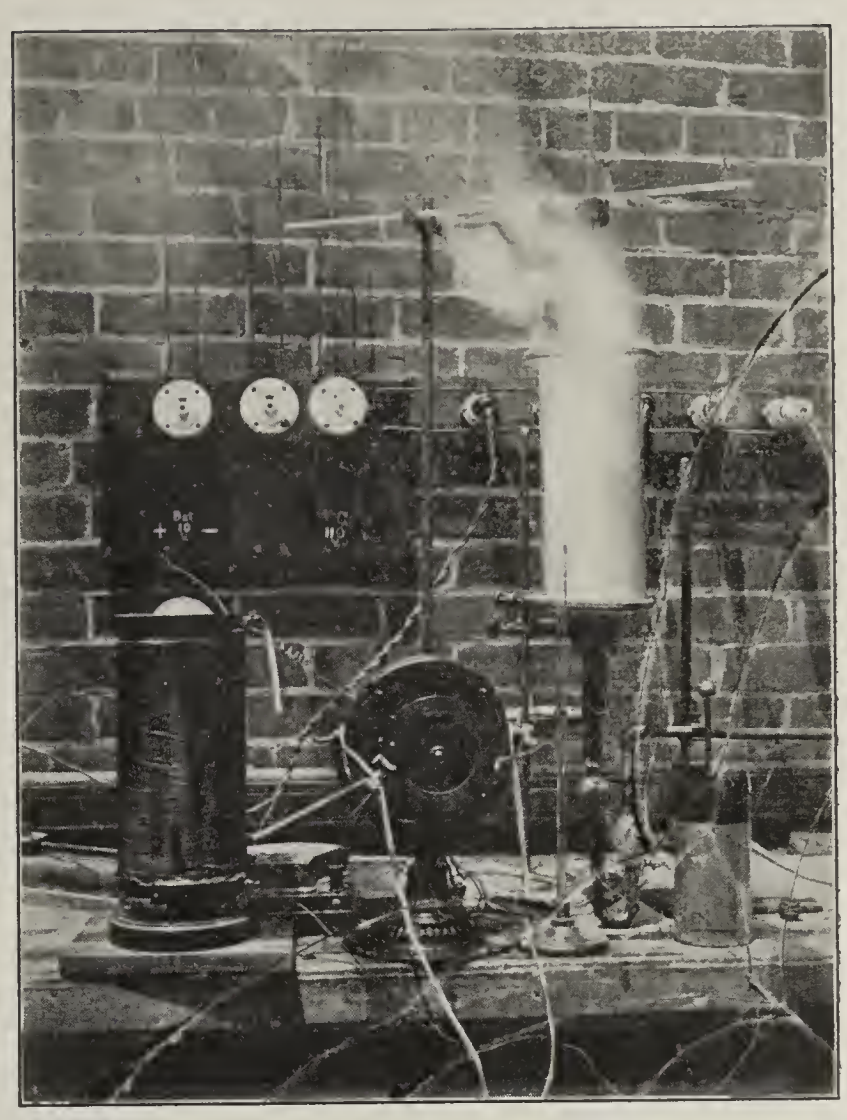


Fig. 2.

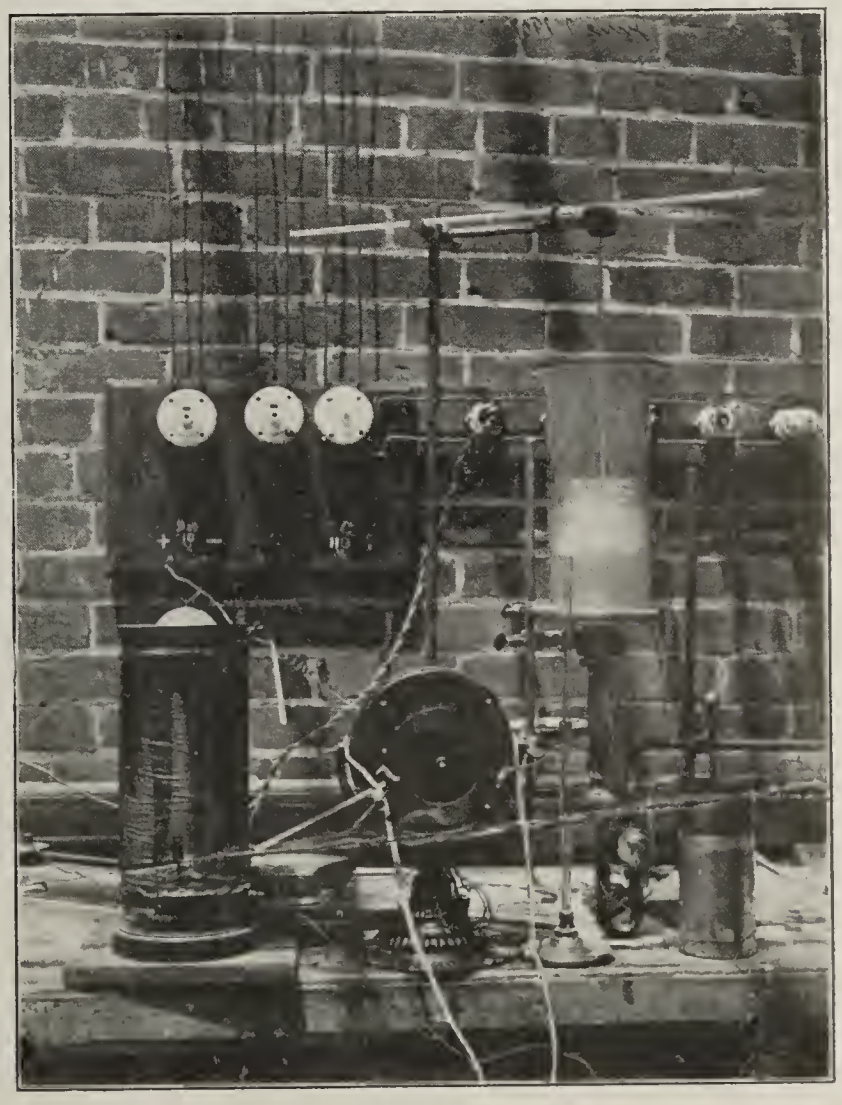


Fig. 3.

*Inventor of process used at the Riverside Portland Cement plant in California for the prevention of dust.

work described in the present paper may fairly be considered as simply the reduction to engineering practice as regards equipment and construction of the fundamental processes long since laid open to us by the splendid pioneer work of Lodge, a feat vastly easier today than at the time of Lodge and Walker's original attempt.

The precipitation of suspended matter whether in gases or liquids may be accelerated by electricity in the form of either direct or alternating current, but the mode of action and the type of problem to which each is best applicable differ in certain important respects.

Where an alternating electromotive force is applied to a suspension the action consists for the most part in an agglomeration of the suspended particles into larger aggregates out in the body of the suspending medium and a consequently more rapid settling of these aggregates under the influence of gravity.

Thus if powerful Hertzian waves are sent out into foggy air the alternating fields set up in space cause an agglomeration of the particles of liquid into larger drops which then settle much more rapidly. Considerable work aimed at the application of this phenomenon to the dispelling of fog on land and sea has recently been done in France and England but very little as to definite results seems as yet to have been published. The field appears, however, one of considerable promise. Another application of alternating current along these lines is found in a process now in use in the California oil fields for separating emulsified water from crude oil. This process grew out of the work here described and was developed some two years ago by Mr. Buckner Speed and the author to meet certain peculiar conditions existing in these fields, but as it is to be described more at length in a subsequent article the details will be here omitted.

Alternating current may thus be used to advantage where the masses of gas or liquid to be treated are fairly quiescent and a simple agglomeration of the suspended particles into larger aggregates is sufficient to effect separation by gravity or otherwise.

In the case of the large volumes of rapidly moving gases in smelter flues the agglomerating and settling process is, however, too slow even when the flues are expanded into as large dust chambers as are commercially feasible. It is in such cases that direct current methods have been particularly important.

If we bring a needle point connected to one side of a high potential direct current line opposite to a flat plate connected to the other side of the line we find that the air space between becomes highly charged with electricity of the same sign as the needle point irrespective of whether this is positive or negative, and any insulated body brought into this space instanly receives a charge of the same sign. If this body is free to move, as in the case of a floating particle, it will be attracted to the plate of opposite charge and will move at a rate proportional to its charge and the potential gradient between the point and plate.

Even if there are no visible suspended particles the gas molecules themselves undergo this same process, as is evidenced by a strong wind from the point to the plate even in perfectly transparent gases. The old familiar experiment of blowing out a candle flame by presenting it to such a charged point is simply another illustration of the same phenomenon.

As above indicated the first step toward practicability was of necessity a commercially feasible source of high tension direct current. The obstacles to building ordinary direct current generators for high voltages lie chiefly in difficulties of insulation, and if this is avoided as to individual machines by working a large number in series the multiplication of adjustments and moving parts intrudes itself. On the other hand, high potential alternating current technique has in late years been worked out most thoroughly, and commercial apparatus up to 100,000 volts is available in the market. The mercury arc rectifier has been made practical for series arc lighting service up to some 5000 volts direct current, but although higher voltage units were at one time attempted by the electrical companies they were later withdrawn from the market as unsuited to practical operating conditions. For high voltages they seem like the static machines to work well under the careful management and light duty of the laboratory but to fail in practice. This is particularly so in the application to metallurgical and chemical work where the electrodes in the flues have to be placed close together and worked near the potential of disruptive discharge, the occasional occurrence of which later places much more severe requirements upon generating apparatus than in the case of the series arc lighting, to which the rectifier seems particularly well adopted.

This restriction does not necessarily apply to the conditions under which fog and smoke would be treated in the open air. It is to these latter cases that Lodge's efforts in late years seem to have been the more particularly directed, and here the mercury rectifier in connection with high potential transformers may find a useful field.

The procedure actually used in the installations described below consist in transforming the alternating current from an ordinary lighting or power circuit up to some 20,000 or 30,000 volts and then commutating this high potential current into an intermittent direct current by means of a special rotary contract maker driven by a synchronous motor. This direct current is applied to a system of electrodes in the flue carrying the gases to be treated.

The electrodes are of two types corresponding to the plate and point in the experiment above cited. The construction of electrodes corresponding to the plate presents no special problem as any smooth conducting surface will answer the purpose. With the pointed or discharge electrodes it is quite otherwise and the working out of practical forms for these has proved the key to much of the success thus far obtained.

In laboratory experiments when the discharge from a single point or a few such is being studied fine sewing needles or even wire bristles answer very well, but when it is attempted to greatly multiply such discharge points in order to uniformly treat a large mass of rapidly moving gas at moderate temperatures great difficulty is met in obtaining a powerful and, at the same time, effective distribution of current.

It may be of interest to note that the clue to the solution of this difficulty came from an almost accidental observation. Working one evening in the twilight when the efficiency of the different points could be roughtly judged by the pale luminous discharge from them, it was noticed that under the particular conditions employed at the time, this glow only became appreciable when the points had approached the plates almost to within the distance for disruptive discharge, while at the same time a piece of cotton-covered magnet wire which carried the current from the transformer and commutator to the discharge electrodes, although widely separated from any conductor of opposite polarity, showed a beautiful uniform purple glow along its whole length. The explanation lay in the fact that every loose fiber of the cotton insulation, although a relatively poor conductor compared to a metallic point, was still sufficiently conductive from its natural hygroscopic moisture to act as a discharge point for this high potential current and its fineness and sharpness, of course, far exceeded that of the sharpest needle or thinnest metallic wire. Acting on this suggestion it was found that a piece of this cotton-covered wire when used as a discharge electrode at ordinary temperature proved far more effective in precipitating the sulphuric acid mists, which were then the object of study, than any system of

metallic points which it had been possible to construct. Perhaps the greatest advantage thus gained lay in the less accurate spacing demanded between the electrodes of opposite polarity in order to secure a reasonably uniform discharge.

In practice of course a more durable material than cotton was demanded for the hot acid gases to be treated and this has been found in asbestos or mica, the fine filaments of the one and the scales of the other supplying the discharge points or edges of the excessive fineness required.

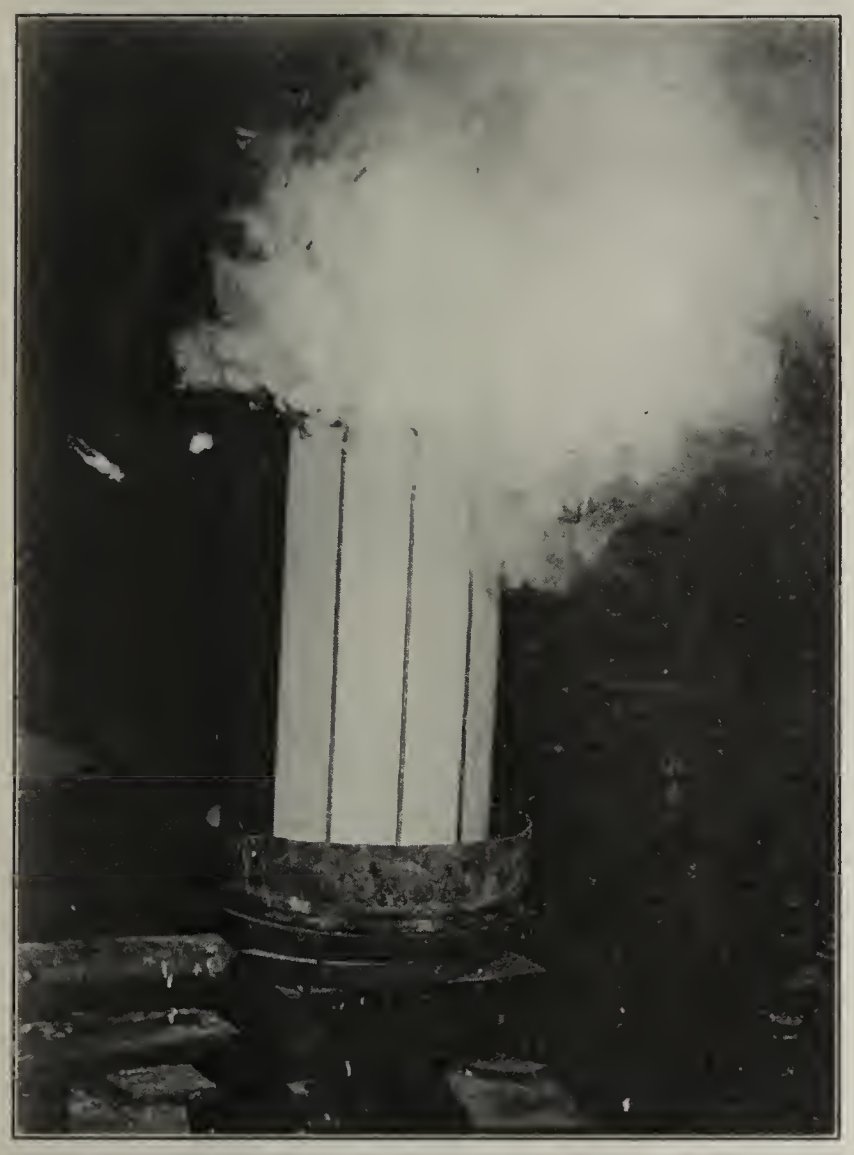


Fig. 4.

These materials are twisted up with wires or otherwise fastened to suitable metallic supports to form the discharge electrodes in such wise that the current has to pass only a short distance by surface leakage over them, the slight deposit of moisture or acid fume naturally settling on them serving to effect the conduction. If the condition of the gases does not supply sufficiently such coating then a special treatment of the material before being placed in the flue is resorted to.

The construction and arrangements of the electrodes as also of the chamber containing them naturally varies very widely with the conditions to be fulfilled under the varied applications to which the process may be put. Some of the more general features of this work are described in the patents already issued in this and foreign countries, while further details and modifications are covered in other patents not yet issued from the Patent Office. The accompanying photographs give perhaps a better idea of the gradual development of the work than any detailed description which would be possible in the space here at command.

Fig. 1 is the apparatus used for the original laboratory experiments in the spring of 1906. Sulphuric acid mist was generated by bubbling the gas from the little contact sulphuric acid plant, seen on the table, through water in the U-tube beneath the inverted glass bell jar, whose inner walls were quickly wetted sufficiently with acid to act as the collecting electrode, a wire being inserted alongside of the stopper through which the U-tube connected with the bell jar and served to connect the jar walls to the induction coil on the left, the latter acting as the step-up transformer. This coil received alternating current at 110 v. from the lighting circuit and gave about 3700 volts at its secondary. The other high potential terminal of the induction coil was connected to the discharge electrode within the bell jar through a make and break operated by the synchronous motor. This latter was improvised by substituting a plain iron cross for the squirrel cage armature in an ordinary fan motor operated from the same 110 v. line as the induction coil, and brought into step by the induction motor on the right. A momentary contact with the discharge electrode was thus established once each complete cycle at the peak of the voltage wave, and served to charge this electrode to the maximum voltage of the line, always with the same polarity. In order to help maintain the charge on the electrode in the interval between these contacts the Leyden jar seen in the picture was connected in parallel with the electrodes. The wire leading to the jar walls or collecting electrode was usually grounded for convenience and safety, as in fact has been done throughout all the practical installations. This leaves but one high potential conductor to deal with in each precipitation chamber and greatly increases the safety of operation.

Fig. 2 is a closer view of the precipitation chamber through which the acid fume is being blown at the rate of about 20 liters per minute, the electric current being shut off the apparatus. Fig. 3 shows the effect of turning on the electric current with the same gas steam still flowing.

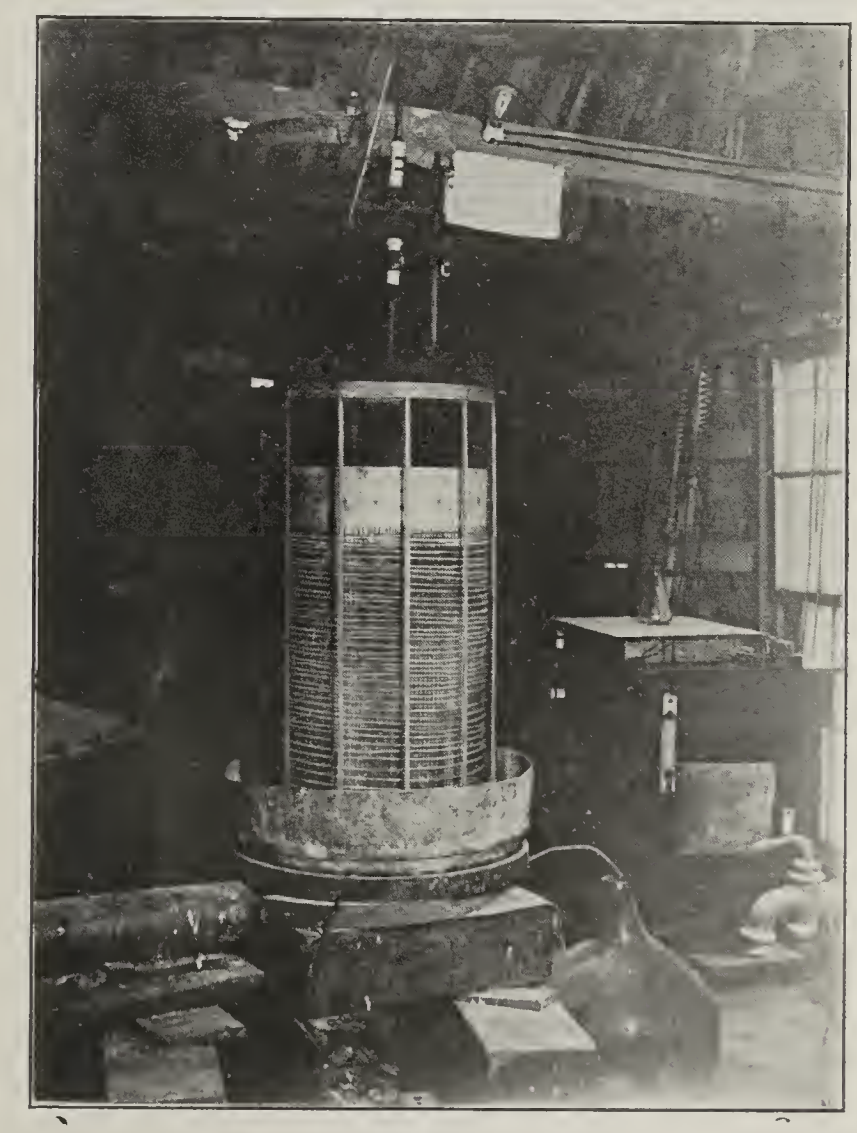


Fig. 5.

The discharge electrode in this case consisted of a cylinder of wire screen wrapped with a few turns of asbestos sewing twine and suspended by a wire passing through a glass tube as shown. The suspended particles of acid were driven away from the asbestos filaments and deposited on the walls of the bell jar, finally running down into the U-tube below.

The next undertaking was to duplicate these experi-

ments on a scale some two-hundred-fold larger. This was carried out during the same summer at the Hercules Works of the E. I. du Pont de Nemours Powder Company at Pinole on San Francisco Bay, where the contact gases from one of their Mannheim contact sulphuric acid units were kindly placed at our disposal. These gases at the point selected contained about 4 per cent by volume of dry gaseous sulphur trioxide, and in order to convert this into sulphuric acid mist they were brought in contact with water. Under these conditions very little of the sulphur trioxide is absorbed by the liquid water, but the latter evaporating into the gas combines with the sulphur trioxide to form the far less volatile sulphuric acid which immediately separates as a dense white cloud of suspended particles so fine as to represent one of the most difficult of all materials to remove by filtration.

Figs. 4 and 5 are photographs taken about a minute apart with the same current of fume-laden gases passing into the precipitation chamber, but with the electric current respectively off and on. The apparatus was the same in general plan as the small laboratory unit described above, except that instead of a single cylinder of wire screen for the discharge electrode, two concentric cylinders were used, while intermediate in diameter between

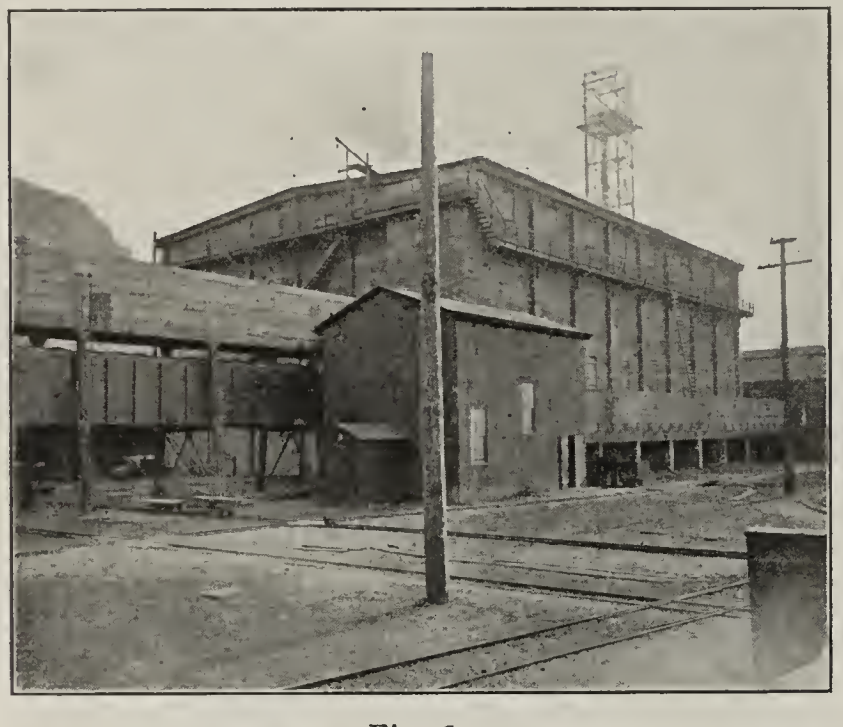


Fig. 6.

these two and resting on the lead pan bottom of the apparatus was a third cylinder, also of iron wire screen, but without asbestos winding, which together with the outer leaded glass cylinder constituted the collecting electrodes. The precipitated acid drained off from this precipitation chamber into the carboy on the right. The space between successive cylinders of opposite polarity was as nearly as possible an inch and a quarter. Current was supplied from three 1-kw. 110 v. to 2,200 v. transformers connected in series on their 2,200 v. side to give 6,600 v. The fume was delivered as before to the bottom of the precipitation chamber at its center and had to pass through the three-wire cylinders and up between the outer of these and the glass container, thus being subjected to three electric fields in succession. In this apparatus the power consumption was about one-fifth of a kilowatt, and between one hundred and two hundred cubic feet of gas per minute could readily be treated. This apparatus was of course merely for experimental and demonstration purposes but a still larger unit built for permanent operation and to handle all of the gas from a Mannheim unit has since been installed at this plant and put into steady commercial operation.

These experiments at Pinole attracted the attention of the Selby Smelting and Lead Company whose smelter located at Vallejo Junction a few miles farther up the Bay was at that time the object of injunction proceedings brought by the farmers of the surrounding country. At the time the suits originated three separate stacks at the Smelter contributed to the alleged nuisance. The first, and admittedly the most serious offender, handled the gases from the lead blast furnaces and discharged several tons of lead fume daily into the air. Shortly before the commencement of our work at the plant this had been obviated by the installation of the bag house shown in

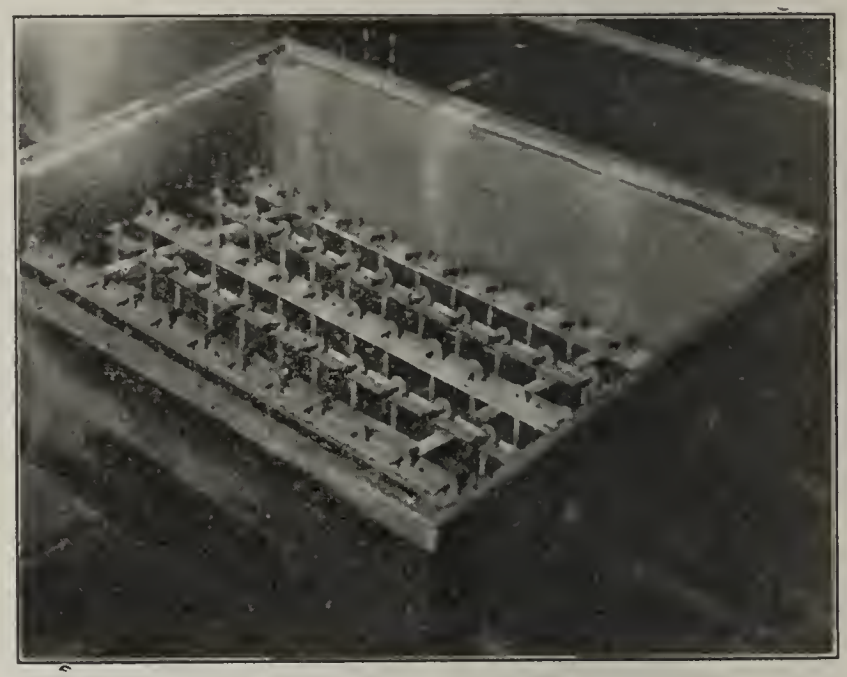


Fig. 7.

Fig. 6. After correcting this evil there still remained, however, a stack discharging the gases from the roasters, which besides the invisible sulphur dioxide furnished dense white clouds consisting chiefly of sulphuric acid, arsenic and lead salts, and to which the bag house was inapplicable on account of the corrosive action of these gases upon the bags. Lastly there was the stack of the refinery carrying the mists escaping from the pots of boiling sulphuric acid used to dissolve the silver out of the gold and silver alloy coming from the cupels.

The blast furnace and the roaster stacks each carried something over 50,000 cu. ft. of gas per minute while the refinery stack represented scarcely a tenth of this volume. As a first step we accordingly commenced operations on this latter, and after several months' experimenting, as to the best form of construction, adopted a system of vertical lead plates 4 in. wide by 4 feet in length and spaced about 4 in. apart. Several rows of such plates were assembled in a 4 by 4 foot lead flue. Between each pair of plates hung a lead-covered iron rod carrying the asbes-

Fig. 8.

tos or mica discharge material, the latter finally proving the more serviceable in this highly acid atmosphere. These rods or discharge electrodes were supported on a gridwork of buss bars extending over the heads of the plates and through apertures in the sides of the flue to insulators on the outside. Fig. 7 is a view looking down on

the top of this flue with the cover removed from above the electrodes. Figs. 8 and 9 show the effect on the appearance of the stack when the electric circuit is respectively open and closed, the stack in the immediate left foreground being the one into which this flue discharges. The

Fig. 9.

large stack in the middle background is from the roasters to be discussed below. Fig. 10 shows the corresponding stream of dilute sulphuric acid (about 40° Bé.) running out from the flue as precipitated. When the acid kettles are at a full boil it often amounts to over two gallons a minute.

The electric current is taken from the power circuit of the plant at 460 volts, 60 cycles, and transformed up to 17,000 volts thence through the synchronous contact maker or rectifier to the electrode system. At first a glass

Fig. 10.

plate condenser was connected across the high potential line in parallel with the electrode system in order to assist in maintaining the potential of the electrodes between the intervals of contact but was found troublesome and unnecessary in practice and in this and other installations is now omitted.

The power consumption for this installation is about 2 kw. including the driving current for the synchronous motor. The switchboard transformer and rectifier are located in the engine room of the plant and require no more attention than a feed pump or a blower. The installation has now been in successful daily operation for over three years at a cost for labor attendance and repairs of less than $20 a month. In fact while the plant was making enough bluestone to utilize all the weak acid recovered, the saving on purchase of the latter paid for the entire cost of operating five times over.

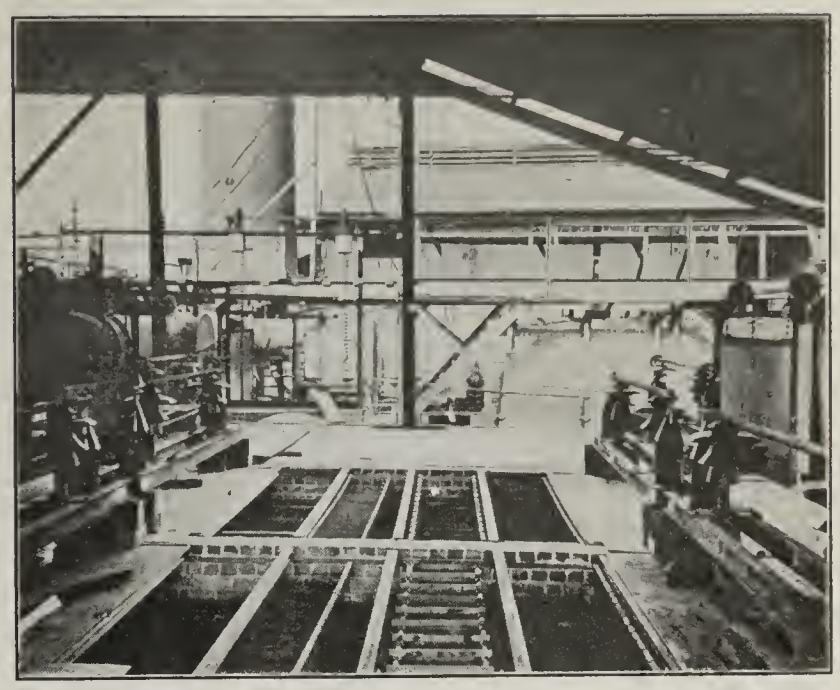


Fig. 11.

The next undertaking was naturally an extension of the process to the treatment of the gases coming from the pyrites and matte roasters of the same plant. This presented a somewhat more difficult problem as the material to be removed consisted of a mixture of solid dust and fume with liquid sulphuric acid. From small scale experiments it was at first thought possible to precipitate the material in a reasonably dry form and shake it in this condition from the electrodes, thus permitting of brick and

Fig. 12.

iron construction. Quite an extensive installation was carried through on this plan, a general view of which is seen in Fig. 11. It consisted of four parallel brick flues or chambers each 22 ft. long, 7 feet wide and 9 feet deep, and containing an electrode system of iron plates as grounded or collecting electrodes and wire and asbestos discharge electrodes somewhat similar in general arrangement to that in the refinery flue. In this case, however, the insulating supports of the discharge electrodes were carried above the flue as seen to right and left in the figure.

Fig. 13.

In practice, however, this type of equipment was found poorly adapted to the particular gas conditions here met with, as a very much higher proportion of free sulphuric acid was encountered than the preliminary tests had given reason to expect, the weight of this free acid often exceeding, in fact, that of all the solids in the gas put together. The gases were also highly charged with water vapor both from the wet ore and the steam atonizing oil burners in the roasters, and this tended further to dilute the acid and produce a muddy deposit. The iron and brick construction made removal of this deposit by washing impracticable so it was decided to further cool the gases and treat them in a lead flue similar to that used in the case of the refinery. However, the experience gained with the large brick flues in which a wide variety of electrodes were tested out, made it possible to compress this new construction into far smaller compass than would otherwise have been thought possible.

Fig. 14.

The resulting construction is seen in Fig. 12. This is a sheet lead flue 6x6 feet across section and 32 feet long, containing 38 rows of 16 lead plates each 6 feet long by 4 in. wide with the corresponding discharge electrodes between each pair. The effect of the treatment upon the appearance of the gases issuing from the stack is shown in Figs. 13 and 14 which, as before, represent respectively the electric current switched off and on being taken about three minutes apart. When Figs. 6 and 12 are compared and it is remembered that in this 32 feet of 6x6 ft. flue about the same volume of gases was being treated as in the bag house measuring about 98x125x55 feet, and further that actual tests showed that even the woolen bags used in this bag house are completely destroyed by these roaster gases in less than half an hour, a better idea may be gained of some of the possibilities which this process appears to open. The power consumption in this case was between 10 and 15 kw. The material precipitated upon the plates was a grayish mud easily washed off and drained out through the bottom of the flue to settlers. For this purpose it was necessary once in about every four to six hours to by-pass the gases, shut off the current from the flue, raise its covers as seen in Fig. 12 and close down the electrodes from above. One man could easily carry out this whole operation in from five to ten minutes. For continuous operation on such material it is of course, necessary to subdivide the treatment into two or more units in order that while one is being cleaned the others may be in operation.

(To be continued.)

WASHING SAND ON CONCRETE JOB.

In the construction of a dam for the waterworks system of Waterbury, Conn., now in progress, the sand used had to be put through a washing process before going in the concrete mixer. Fortunately a bountiful supply of sand was found in the bottom of the valley, upstream from the dam. While the sand is sharp and well graded it requires washing to remove the large amount of silt. The sand is dredged by two orange-peel buckets and piled near the sand-washing plant. Later the sand is lifted to screens over the washing box by the grab buckets where all the large cobbles and stones are screened out, the sand passing the screens, to be fed slowly into the washing box. Washing is accomplished by feeding the sand after screening into a box where jets of water issue from a series of perforated pipes in the bottom of the box. The waste water containing the silt overflows into a trough at the top of the box and runs off to a settling basin. The washed sand runs out at a slide valve in the lower end of the box, into small 1¼-yard cars, which are conveyed to the foot of the west hill and hoisted to the top by a derrick, where they are again placed on track and run to the mixer. The thoroughness of the washing depends on a sufficient amount of water being pumped to the washing box. An average of 0.5 percent of silt has been maintained in the washed sand, thus making a clean, sharp sand having a uniformity coefficient of about 4.155 as an average.

Ornamental Concrete Illuminating Standards

In the country-wide movement for civic beauty which has interested property owners as well as national, state and municipal officials and has resulted in the creation of municipal art commissions and municipal art clubs and associations in all of the large and nearly all of the smaller cities for the closer study of civic improvement, the ornamental illuminating standard is receiving a great deal of deserved attention along with other equally deserving details.

The present ornamental illuminating standard is the result of years of development from the old wooden post with the kerosene lamp of years ago, through the crude cast iron gas lamp-post of which many still exist, to the period of wooden posts with metal arms from which were suspended the early arc lights. From this point on, the subject of lighting standards began to receive attention from the artistic as well as the utilitarian standpoint. In all instances metal was the medium.

ENTRANCE TO WILEY HIGH SCHOOL, TERRE HAUTE, IND.
Showing Ionic Concrete Column with Pedestal for Ornamental Illumination and Having Single-Light Head.
Manufactured by the Pettyjohn Co., Terre Haute, Ind.

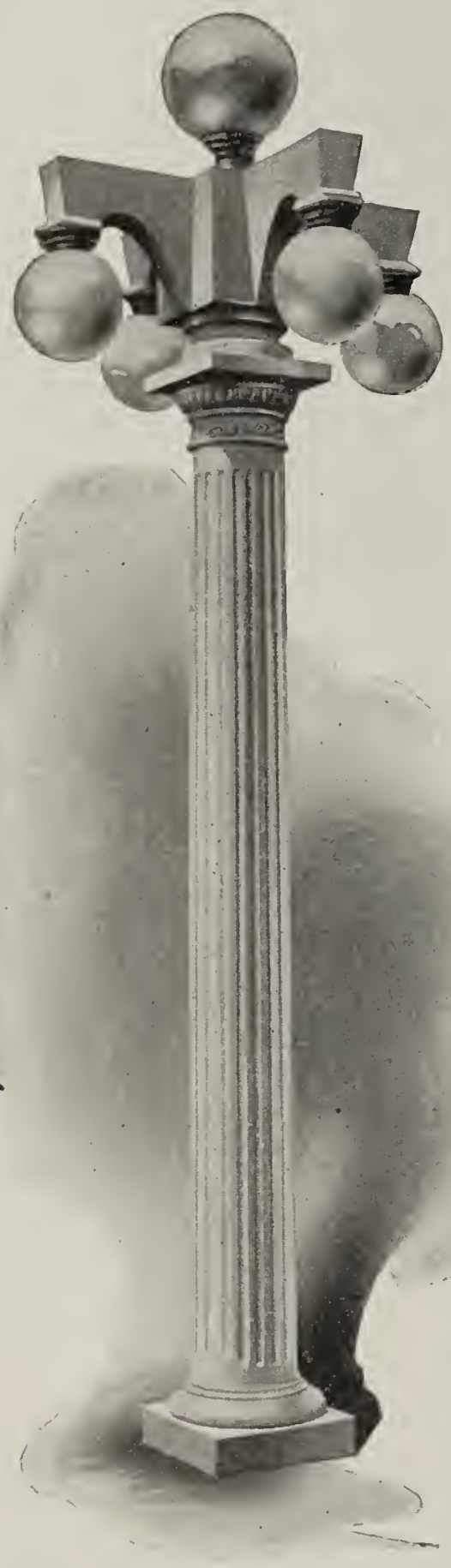
The benefits to be derived from better street lighting are such that they can hardly be overestimated, and the fact that a large percentage of the installations made up to date are due wholly or in part to private enterprise and the employment of private capital, leaves no doubt that the benefit secured and the purpose accomplished fully justifies the expense.

In business property particularly, it is a generally recognized fact that the value is directly proportionate to the number of people who pass it. It is also a generally accepted fact that the crowd will follow the light and especially so if the light is presented in the most artistic and attractive form. Property on any public thoroughfare can be increased in value, as can the streets tributary thereto, by a good system of ornamental illumination. This equally applies to residential districts and boulevards. In public park development, the ornamental illuminating standard is almost as indispensable to the artistic scheme as is its primary purpose of illumination.

The latest and highest development of the subject of illumination has served to discard the old theory of high candle power at long distances apart and high in the air in favor of the far superior method of lower candle power at shorter distance and nearer to the sidewalk and street levels. The low-candle-power-at-short-interval plan gives the advantage of uniform distribution of light, avoids dark spots, prevents accidents, lessens the possibility of robberies, is easier on the eyes and is generally more agreeable and attractive. The latest and highest development of the ornamental illuminating standard has resulted in the reinforced granite concrete illuminating standard in which can be readily combined beauty, utility and economy.

The artistic possibilities of the reinforced concrete ornamental illuminating standards are practically unlimited. The Doric design illustrated is a good example of what can be done. This standard was produced by the Pettyjohn Company, Terre Haute, Indiana, and repre-

sents perhaps the highest development of the reinforced concrete standard. This standard has the granite finish with all of the appearance and durability of granite. It is distinctly an improvement on the concrete lamp post especially designed and used by the commissioners of Lincoln Park, Chicago, which have attracted so much interest and attention from the entire country. Their use on



Granite Concrete Lighting Column. Doric Design with Five-Light Cluster.

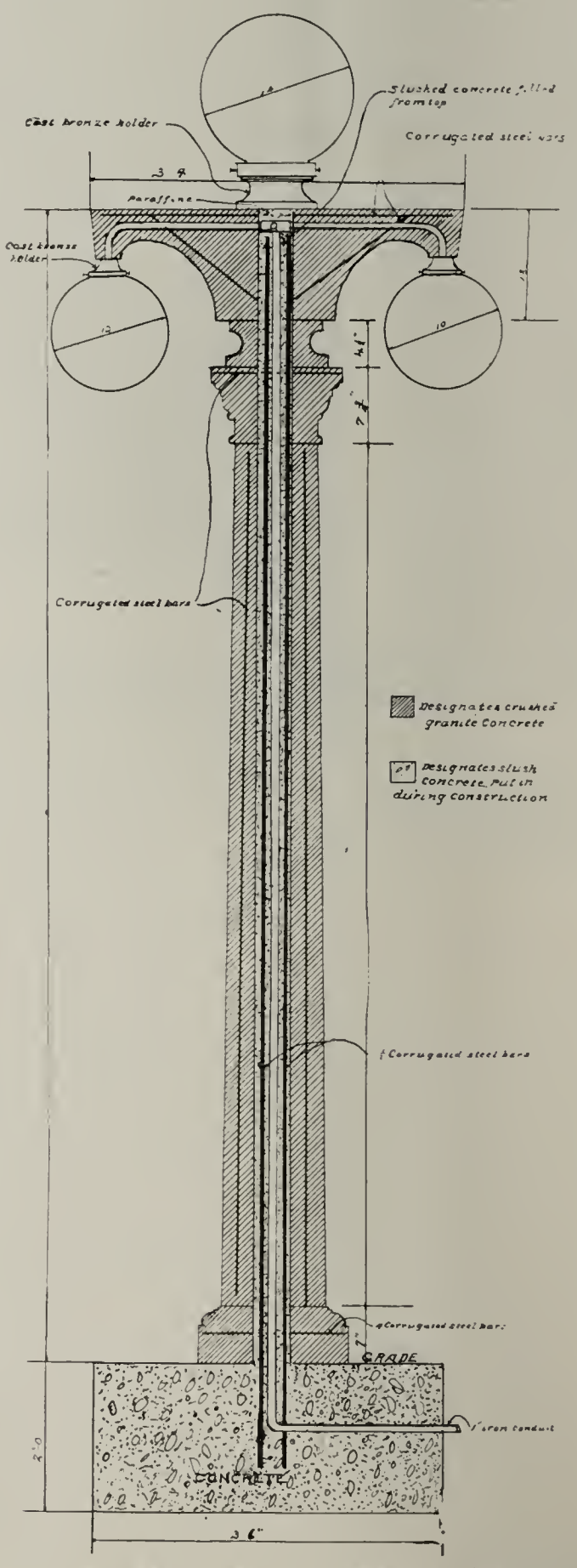
Wabash Avenue, Terre Haute, is the best example of what they can accomplish in the dual purpose of illuminating satisfactorily and adding to the attractive appearance of the street.

In point of economy, it may be said that the cost of the ornamental granite concrete standards at Terre Haute is about one-tenth of the cost of natural granite and about on-half the cost of cast iron. The freedom from painting and other repairs put them quite in a class alone as to the cost of maintenance.

As to durability, we have not as yet found a material which will outlive concrete. In the ornamental illuminating standard, the reinforced concrete standard will be standing practically unaffected long after the metal standard has passed on to the junk heap.

Because of its many advantages, the ornamental reinforced concrete illuminating standard has come to us to stay. The sooner the advantages are studied and appreciated by those interested in civic improvement, the more artistic, the more durable and the more economical will be the plans for beautifying the cities, parks, boulevards, streets, and residential districts which are the object of their endeavor.

The standards are molded in heavy substantial cast iron molds from material of a special formula containing actual crushed granite which has been developed by the Pettyjohn Company after many years of experience in connection with the manufacture of ornamental concrete products. All members are reinforced during the process of manufacture. Four corrugated bars of one-half inch diameter being used longitudinally and seven three-eighth inch diameter corrugated bars bent to a circular shape and being placed a foot apart. The standards are molded



Sectional View Reinforced Concrete Lighting Standard.

hollow so as to permit of the insertion of gas pipes, electric wires and conduits, and when erected, this central space is filled with slush concrete and reinforcing rods so that the standards are then solid and reinforced with three distinct systems of reinforcing, some of which run from the standard itself into the foundation, thus giving great strength and stability to the standards and affecting much economy in the freedom from breakage of globes or the filaments in the electric bulbs.

Practical experience has shown that blows which would completely demolish an iron standard and break all of the glassware upon it, would have but little effect upon the reinforced concrete standards which are heavier, more massive and more substantial in every way. Time has not the slightest deteriorating effect upon these standards, and should they become chipped by a runaway or other violence, the place can easily be repaired with the same composition with which the standards are made, and so perfectly as to be not noticeable.

In the manufacture of the standards after the molds are removed, they are given a surface treatment which brings out the life, sparkle and glisten of the natural granite and later they are given another surface treatment which has the effect of rendering the standards thoroughly waterproof, sealing all the pores and still further increasing the hardness of the exterior surface.

In addition to the granite concrete which has a surface molded like natural granite, the standards are also made in pure white, several shades of gray and buff, and upon special order are manufactured to match various kinds of natural stone. For installations in which durability, general appearance and economy are the important factors, and the character of the surface texture of minor consideration, the standards are made of the ordinary sand and cement mixture at about one-half the price asked for the granite concrete standards. The buffs, grays and whites are sold at intermediate prices.

While but one design is illustrated in connection with this article, the company has numerous other stock designs and in addition to this is prepared to make the standards in special designs, sizes and with various surface texture, so that the possibilities are almost unlimited.

The Pettyjohn Company has issued an attractive booklet entitled Ornamental Illumination which will be mailed gratis to interested parties.

THE ROTARY KILN.

By E. S. Fickes.

The history of the development and utilization of the rotary kiln is one of the most remarkable instances in modern engineering of neglecting to develop and use a valuable apparatus for years after its invention.

In the British patent granted to Chas. W. Siemens in 1869, Mr. Siemens states that he is well aware of the previous employment of revolving cylindrical calcining apparatus and he, therefore, makes no claim of novelty for the rotary kiln described in his patent. His patent is of great interest, however, on account of the broad grasp of the possibilities of the rotary kiln displayed by Mr. Siemens in drawing it. In his application Mr. Siemens mentions the use of his invention for the "calcination of metallic ores and also the burning of such substances as cement, lime or plaster of paris." His patent covers methods for utilizing the waste heat from the rotary kiln, the total calcination of metallic ores by bringing the heated ore into contact with heated atmospheric air alone, this being accomplished by advancing the point of combustion any desired distance into the rotating kiln, the introduction of jets of steam among the heated and partially reduced ores to produce further chemical reactions, the introduction of pulverized or liquid fuel into the kiln by means of a steam or air jet, the combination with the rotary kiln of a condensing chamber for the saving and utilization of sulphurous and other useful gases, the combining of such calcining apparatus with a smelting furnace so that the heat in the freshly calcined ore could be utilized in the smelting furnace, and the construction of the rotary kiln with a closed water-jacketed receiving chamber for the purpose of cooling pulverulent calcined materials without oxidation. It would be of interest to know something about the rotary calcining apparatus which was in use prior to 1869 when the Siemens' patent was granted, also to what extent the rotary kiln was developed and utilized under the Siemens' patents.

In 1885 patents were granted to Ransome for a combination of a rotary kiln and gas producer and some commercially unsuccessful attempts were made in England to use the apparatus to burn Portland cement under this patent. As stated by Mr. Soper, a year later the real development of the rotary kiln for making cement began in this country. While producer gas was used successfully as fuel in one or two instances, it was soon found that it could not compete with powdered coal for burning cement clinker. For drying or calcining many materials, however, the use of powdered coal is very objectionable or even entirely out of the question on account of the ash from the coal mixing with the material under treatment and in such cases liquid or gaseous fuel must be used. Natural gas or oil is to be preferred, but their cost often necessitates the use of producer gas.

While the rotary kiln within the last ten years has come into general use in the cement industry, its use for drying, roasting and calcining other materials is by no means so great as is warranted by its utility and the economies which can be effected by its use. Although the Siemens' patent mentions the burning of lime, and Henry Mathey was granted United States patents in 1885 for a process for making lime by crushing the stone to a suitable fineness and then burning it in a rotary kiln, the writer does not know of lime being successfully burned on a commercial scale in a rotary kiln in the United States until 1893 when it was so made by the California Portland Cement Company. In 1905 or 1906 the New York Lime Company started to burn lime at Natural Bridge, N. Y., using a 100 ft. by 6 ft. rotary kiln fired by gas from a 10-ft. Morgan producer, and in 1907 both the Union Carbide Company and the Aluminum Ore Company built rotary kiln lime plants, the latter using 120-ft. kilns and having a capacity of from 200 to 300 tons of lime per day.

In 1902 the writer installed a 60 ft. by 5 ft. rotary kiln for drying and dehydrating bauxite, using producer gas as fuel. Since then he has built additional drying plants of this type and several similar plants for chemical industries, one of which consists of four 120 ft. by 7 ft. rotary kilns employing a temperature of 2000 deg. Fahr. for dehydrating salts containing chemically combined water. The fuel used is producer gas and an elaborate separating and gas washing apparatus was installed in connection with this plant to save the valuable dust carried off by the waste gases from the kilns. In none of these plants could powdered coal be used on account of the ash resulting from its combustion.

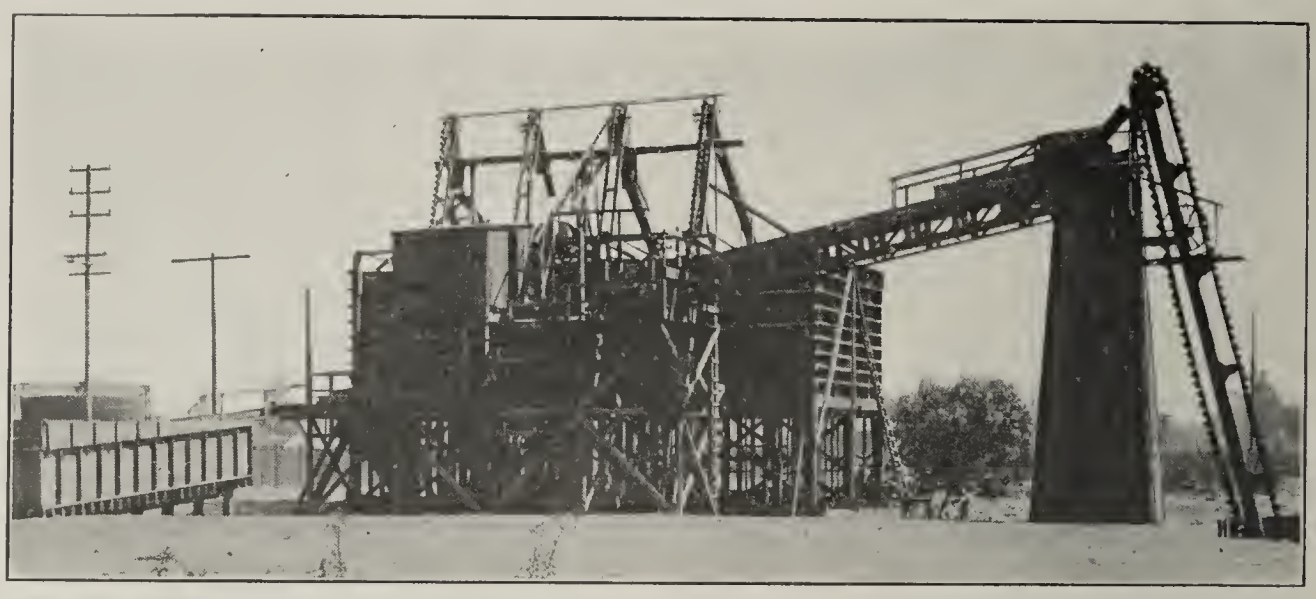
The writer quite agrees with Mr. Soper regarding the use of the rotary kiln as a direct heat dryer and has used it in preference to patent dryers whenever the output and character of the material to be dried would warrant its use. Used as a dryer, the simple and strong construction of a good rotary kiln insures a large output with low maintenance cost and few interruptions, which is far from being true of many other kinds of dryers. The limited use of the rotary kiln as a dryer is only less remarkable than the slow progress it has made in chemical and metallurgical plants where it can often be used in place of much more expensive and less efficient apparatus.

Washed vs. Unwashed Sand and Gravel

By Colby M. Avery

This concrete age is making such rapid strides in building and bridge construction, and in general engineering work that it has brought out many new methods of preparing and testing the ingredients entering into its construction.

High grade architects, engineers and contractors are now demanding in their specifications, clean materials, free from loam, clay and dirt. The reason for this demand is that where stone or gravel is used that is coated with dirt of any kind, the cement cannot reach the stone, but is allowed to set up against this film of foreign matter which serves only as a form for the cement; the concrete will thus have only the strength of the cement as it cannot become thoroughly fastened or united with the sand and stone or gravel. Where washed sand and gravel is used the cement coats the clean surface of the material used in the concrete during the dry mixing, and then when wet, the cement fills every void or cavity, both in the gravel



Plant for Washing and Grading Sand and Gravel, the California Washed Sand & Gravel Co., 1600 Shearer St., Los Angeles, Cal., Owners. Five Grades of Material Are Delivered from This New Plant from a 30-mesh Screen to As Small as a ¾-Inch.

used and the spaces between the sand and gravel. A good illustration of this is cited in the history of a large contract for a concrete building erected in New Brunswick; we will quote from a paper by E. S. Larned, C. E., Boston, read before the National Association of Cement Users at its convention held in Milwaukee in January, 1910:

"It is gratifying to note the growing appreciation of the important part sand plays in all cement work; in very many instances poor results are directly chargeable to the sand used. No cement will improve properly if mixed with very fine sand and results will vary with the characteristics of the fine material. It must also be kept in mind that an intimate mixture of cement and fine sand is very difficult to attain, and a thorough distribution of cement throughout the sand voids is absolutely essential to good results. Sand that looks good is not always above suspicion; the following instance will serve to show the importance of testing the sand before use. An important hydraulic work was begun last spring at New Brunswick, and the contractors and engineers had congratulated themselves upon having what appeared to be an ideal deposit of sand and gravel for concrete work. The cement was thoroughly tested with standard sand, with good results. When everything was ready an active start was made and considerable concrete was placed before any doubts arose; it would not set up, however, in a week's time (or longer as it proved) and the cement was immediately tested again, with favorable results, and then some of the sand was examined. On the washing test it was noticed that a light opalescence was imparted to the water, remaining in suspension several days, but leaving practically no deposit or sedimentation. The cement was then tested with this sand before and after washing, and the trouble was at once located. The sand and gravel were both washed thereafter, and good results followed."

Also from a paper by Sanford E. Thompson, M. Am. Soc. C. E., Newton Highlands, Mass. (See Feb. number Municipal Engineering for complete paper):

"Comparative tests indicate that different stone for concrete in order of their value are as follows: (1) Trap, (2) Granite, (3) Gravel, (4) Marble, (5) Lime Stone, (6) Slag, (7) Sand Stone, (8) Slate, (9) Shale, (10) Cinders. The hardness of the stone grows in importance with the age of concrete. Thus gravel concrete, because of the rounded surfaces, at the age of one month may be weaker than a concrete made with comparatively soft broken stone, but at the age of one year it may surpass in strength the broken stone concrete, because, as the cement becomes hard, there is greater tendency for the stones themselves to shear through and the hardness and smoothness of the gravel stones thus comes into play."

Many other instances can be cited where concrete structures have failed by the using of dust covered sand and gravel. In one instance a pier was built where only a loamy sand was available; after a week's test the concrete was like putty and would not set harder. This work had to be replaced with clean washed sand and washed gravel. Sand and gravel when pumped or dredged from the bottoms of rivers and lakes is not fit for use without being first washed by a process that will roll and tumble it in fresh circulating water; the particles are generally coated with slime and dirt that can only be removed in a washer.

The best principle for a washing plant is one that will roll and tumble the sand and gravel in a rapid running stream of water. It should also size the gravel and allow the oversize stone to fall into a crusher which will redeliver its product to the first washing

screen, thereby saving and washing all the product of the bank. The successive steps of screens will make any number of sizes and the fine sand can also be separated from the coarse by the process. Sand is saved by passing the refuse into receiving tanks, from which the clay and dirt passes off in solution with the water, leaving the sand to settle clean and free. This method allows the contractor to purchase material of exact sizes specified by the architect or engineer, and he is enabled to get both coarse and fine sand to fill any specifications that may be demanded.

The design of washing and screening plants should best be undertaken by engineers familiar with the machinery used and with its operation under various conditions. Certain bank gravel is entirely suitable for concrete work provided it is properly screened and graded according to the commercial requirements. The quality of the gravel should be determined, however, before the plant is erected as it is naturally cheaper to make the arrangements first for washing the gravel than to make the change after the plant has been built for dry screening. If the necessary water can be easily procured the cost of washing the gravel while it is being screened is very low and little additional equipment other than the pumping apparatus is required.

There is a large profit in the production of washed or screened gravel where there is a local market for the same. In most sections of the country there is a great demand for the material and it commands a price of from 35 to 75 cents per cubic yard and may be profitably shipped to a territory within a radius of one hundred miles or more.

In a properly designed plant, the cost of producing clean, sized gravel varies from 10 to 18 cents per cubic yard for material ranging in sizes from 3-32 of an inch to 2 inches.

GRAVEL WASHING PLANTS.

The Link Belt. Co., Chicago and Philadelphia, are designing and building a great many gravel washing plants throughout the country. They are prepared to furnish machinery equipments for the efficient and economical handling of crushed stone and gravel, including belt conveyors, open top corners, screens, continuous bucket elevators, etc. Their engineers have had broad experience in designing, elevating and conveying machinery for handling materials of every description—the benefit of their knowledge is at your service.

TO DOUBLE CAPACITY OF SAND LIME BRICK PLANT.

The Saginaw Sandstone Brick Company, of Saginaw, Mich., will increase its capital stock from $25,000 to $50,000. It was also decided to double the size of the plant, constructing a sufficient addition and installing more machinery so the capacity will be increased from 25,000 brick to 50,000 brick a day. The reports of the firm showed the business to be in a fine condition, with future prospects bright.

WANT LOWER RATES FOR CEMENT.

Kansas cement manufacturers are attempting through a suit to obtain a reduction in railway rates on cement to points in Missouri, Iowa, Nebraska, Oklahoma, Texas and North and South Dakota. A. R. Mackley, special examiner for the Interstate Commerce Commission, heard the testimony of railroads and the shippers yesterday in the federal building. The hearing will continue two days.

PAINTING OVER CONCRETE.

There never was a more unlikely surface to paint over than that formed of cement, or concrete. We painters can make a go of paint on almost anything, but this stuff has somewhat stumped us, sure. In the first place, cement is alkaline, and lye and oil are a bad combination as a paint coating. There you are. And paint for cement must be different in that it must penetrate the stuff more than wood, filling the pores and making a solid surface. If the cement is exterior and has stood against sun, rain and all the other elements, for months, the alkali will have greatly lost away, and then ordinary oil paint has a chance of staying on. In fact, a new concrete or cement surface never should be coated, but should be left to exposure for a year at least. Then there is the matter of dampness. Cement or concrete, the same thing, holds moisture a long time, and also takes up moisture readily, hence we have this to combat. Paint is impotent against moisture from beneath.

The neutralizing of the lime or alkali in the cement with an acid works badly, as it causes chloride of lime to form, which crumbles and destroys the cement. Muriatic acid of 7 or 8 per cent dilution has been used. Sulphate of zinc is a better thing to use, adding an equal weight of water to it. The zinc sulphate uniting with the lime forms sulphate of lime or gypsum. There does not seem to be any injurious action set up by this preparation, and painters have been using it successfully for some time now. A coat of the solution is well brushed into the surface of the concrete, with a stiff brush, and in the course of two or three days it is dry, hard and firm, ready for the paint.

Another method is to employ carbonate of ammonia, ten pounds to the 45 gallons of water. Apply a coat with a brush and leave it to dry. This produces insoluble calcium carbonate on the surface, the major portion of the ammonia being set free in the process of drying. The surface is ready for the paint when dry, and no injurious action follows its use. Where lime mortar is used, as in plastering or stuccoing the exterior of a building, it is best to apply two weak coats of this solution, rather than one strong coating.

There is now on the market waterproof stains for coating cement surfaces, coloring the work and rendering it proof against rain or dampness of any kind. These colored stains are said to wear well, holding their color as well as any ordinary paint, and the colors are soft and pleasing. Renewing the coating once every three or four years keeps the work looking fresh and attractive.

From a French source we hear of a coating that is said to hold back the alkali and serve as a priming coat, over which any regular paint may be applied. Here is the formula:

White pigment	70
Kerosene oil, 150 deg	10
Raw linseed oil	10
Water and lime solution	4
Fat linseed oil	3
Liquid japan drier	3

The white pigment may be white lead or lithopone, or zinc and white lead for exterior work, and all zinc or all lithopone for interior work. The white pigment should be ground in pure raw linseed oil and kerosene, mixed; the other ingredients to be added after grinding.

The water and lime solution is made as follows: Weigh out 10 pounds of fresh lump lime and pour over it 3 gallons of hot water, in a suitable vessel, which cover over to keep in the heat. After 12 hours decant the liquid and filter it through several thicknesses of cheesecloth.

"Why is concrete painted?" For the same reason that wooden buildings are painted, namely, to beautify and to waterproof. There is no building surface that looks so unsightly as cement. Then, as long as the cement surface is unpainted it absorbs moisture, and paint is to prevent this. Will linseed oil paint answer? Yes, if the cement surface is in proper condition to receive the paint, and this is just as true of wooden surfaces. I have spoken of this already. I find some advocating soda water, such as the druggist gets in cylinders under great pressure, carbonic acid water. This is brushed on, or sprayed on, as you choose. The carbonic acid kills the alkali. In fact, it is about the same process that nature employs, only in a quicker way.

A writer in "Concrete" tells how to mix a white lead paint for coating over cement. He says to mix 100 lbs. white lead with 9 gallons of boiled oil, or the same of raw oil with the addition of three half-pints of japan drier and one pint of turpentine. That is for the priming coat. Some painters prefer a primer of red lead, using at the rate of 85 lbs. red lead, dry, one gallon boiled oil and one quart of turpentine. I would add that as it is difficult to get real boiled oil it is best to use the raw oil with japan added. For the second coat he indicates 100 lbs. white lead, 4 gallons pure raw linseed oil and one pint of turpentine. Or one-third boiled oil and one-third raw oil, mixed, may be used. For the finishing coat, 100 lbs. white lead 3½ gallons linseed oil (one-third boiled and two-thirds raw), or 3½ gallons raw oil and one pint driers and one pint turpentine. There is no reason why ordinary paint should not do as well on properly prepared cement as on wood, brick, stucco or stone. The protective stains mentioned are all right, and if paint is preferred it too may be all right. But the surface for paint must be strictly all right or the result will be disappointing.

SANDUSKY RESIGNS FROM THE ASSOCIATION.

The Sandusky Portland Cement Company of Sandusky, O., one of the largest producers of Portland cement in the United States, operating mills at Bay Bridge, Ohio, Syracuse, Ind., Dixon, Ill., and York, Pa., has resigned from the Association of American Portland Cement Manufacturers, at the close of the December meeting.

Mr. S. B. Newberry, the vice-president and general manager of the Sandusky Portland Cement Company, is one of the most competent and experienced experts in the industry. The American cement industry is indebted to Mr. Newberry possibly more than to any other single individual, in bringing it to its present high state of development, as he rendered invaluable technical services when the industry was struggling for a name and it is with regret that we note his company's resignation from the Association of American Portland Cement Manufacturers.

A MIXER WITHOUT FRILLS.

A strong durable machine that will give a maximum of good, honest, concrete at a minimum cost of production—this, in a nutshell, describes the features of the Blystone Batch Mixer which commend it especially to concrete contractors and cement users.

This new machine, which is made by the Blystone Machinery Company, Cambridge Springs, Pa., first attracted prominent attention at the Chicago cement show a year ago, and has since had a successful and steadily increasing run of business. The company has lately moved into a new and modern factory building, with an equipment insuring prompt and efficient attention to orders.

The machines are put out in different models adapted to all kinds of work and methods of driving. The mounted mixer with power is mounted on strong 4-inch channel steel frames and equipped with the well-known "Famous" gasoline engine of 2 h. p. This same engine is furnished with the hand mounted mixer, which is mounted on hand trucks so that it can be pulled around from one place to another by hand and at the same time is well adapted to shop use.

The strong points of the Blystone Batch Mixer may be summarized thus:

1. A reverse set of paddles that cut, blow and turn over the material, insuring a thorough mix.
2. Mixing drum open to full view so that wetting can be done accurately.
3. Cleaned as easily as washing out a wheelbarrow.
4. Fitted with speed reducing gear and tight and loose pulleys, and can be belted direct to engine or motor.
5. Economical of power, as it requires only a 2 h. p. engine or motor to operate it.
6. Will mix a batch of 3½ to 5 cubic feet in one minute—equal to 50 to 60 cubic yards per day.
7. Built entirely of steel and iron with semi-steel arms, and so strong and simple in construction that cost for repairs is reduced to the minimum.

The company's new illustrated catalogue will give full particulars, and every cement user should write for one. The mixer problem is one of the most important in its bearing on the success or failure of the concrete worker. Write the Blystone Machinery Co., 50 North Ave., Cambridge Springs, Pa.

Practical Concrete Construction—Arriving at Cost Figures

By DeWitt V. Moore

This paper contemplates a practical study of concrete construction with particular regard for costs and efficient methods of construction, and no attempt will be made to enter into the theory of design.

Concrete is a peculiar building material, in that it is manufactured on the job, whereas stone, brick, steel and wood are delivered on the site ready for installation into the structure. The cost of stone as delivered is determined by its quality and hardness, and distance of transportation and the cost of quarrying and dressing. The cost of the brick as delivered is determined by the quality of the clay from which it is produced, the methods of manufacture, the quality of the product and the distance of transportation, and also the cost of labor to handle, sort and select. The cost of steel is more nearly consistent, but even this material is affected by the character of the material, the shapes into which it is rolled, the size of such shapes and the distance of transportation. The cost of the timber is likewise affected by the character or the kind of wood, the size of the pieces and the grade of the timber and the distance of transportation.

In all of the foregoing standard building materials no man would think of bidding without first ascertaining what was required and then obtaining a price from those who were qualified to furnish the specified material.

In the case of concrete, it appears that in most cases the elements entering into the construction are entirely overlooked, and concrete is treated in the estimate without any regard to the varying character of materials and proportions entering into it.

This statement is not as true now as it was a few years ago, but the fact is still shown in a great many proposals.

Selection of Gravel or Stone.

Most specifications allow either gravel or stone to be used. Where good gravel can be obtained it is preferable from a cost standpoint to stone, and it is more easily handled throughout the entire operation of mixing and placing. Broken stone is usually obtained from quarries and must be transported by railroad cars, unloaded by hand and then hauled to the location of the work. Gravel, on the other hand, when loaded is hauled directly to the site of the work. From a cost standpoint, we have, therefore, two reasons why gravel is preferable:

First—Under ordinary conditions there is less manual labor connected with its delivery.

Second—There is less cost for manual labor for gravel than stone, due to the nature of the material as a laborer can do approximately 20 per cent more shoveling with gravel than with stone under equal conditions. If the gravel is good the resulting work is equal to or better than broken stone concrete. A good gravel for concrete should be of varying sizes, wherein the sizes of the pebbles range downward in a size, say, 2½ inches to ¼ inch, the proportion of each being such that there is approximately 50 per cent of each size with reference to the next largest. Concrete made of such materials will be homogeneous, dense and of great strength. Either gravel or stone should be watched very carefully for foreign materials, such as lumps of clay from stripping the hard pan strata, sticks, decayed matter, etc. So-called yellow gravel is not necessarily a sign of weakness, although such a deposit should be carefully examined. Many times such a surface discoloration is caused by a washing over of the gravel of deposits or strata of oxide of iron or other minerals.

Selection of Sand.

Much that has been said about gravel may be applied to sand, except that the sand, in a sense, is more important than the gravel. The sand should be relatively clean and of varying-sized grains. Such a sand is much better than when of even-sized particles, and I think I am safe in saying that silt up to 5 per cent will not affect the strength of the resulting concrete; but if sand is silty to any such extent care must be taken that the work is cleaned every morning. This same advice applies to the gravel, for if this is not done there will come to the surface of each day's work a soft, slimy substance, laitance, which has no strength and which will form a stratum of demarcation between the successive courses.

Many times the writer has heard experienced workmen criticise the cement used because of just such conditions, on the theory that the cement rose to the surface and did not mix properly with the aggregate. Other things being equal, it is better to import sand at an increased cost, using local gravel, than to use local sand and import gravel and stone.

Selection of Cement.

At the present time there are so many brands of Portland cement of recognized value that as far as quality is concerned little can be said.

When it comes to large and important work, however, it is well to consider the capacity of the plant and be sure of its ability to deliver the cement on time and in the quantity required.

Selection of Machinery.

Various types of work naturally demand various types of machinery and arrangement, but in general it may be said that a small mixer is not economical. In general, each batch from the mixture should be handled as a whole as closely as possible to the place of deposit. The wheelbarrow is no longer the primary method of transportation of concrete, but rather secondary, and stands in the same relative capacity as shovels, hoes, etc. There is no doubt as to the majority of opinions being in favor of batch mixers, but whatever the type adopted, it will be well, in the long run, to install 20 to 25 per cent more boiler and machine power than is specified by the manufacturer.

When Hand Mixing Is Justified.

Hand mixing cannot be expected to be as uniform as that done by machine, and yet if proper care is taken under intelligent supervision good results can be secured.

From a cost viewpoint, hand mixing is preferable; first, when the work is so small as not to justify the installation of a machine. For instance, on a job of a couple of hundred yards, $100 would probably be expended in installing and rigging the mixer, or at the rate of 50 cents per yard, and it is doubtful if hand mixing would cost any more than this difference. Hand mixing is preferable in connection with large work where, in order to reach isolated portions of the work, it is more economical to mix by hand than to wheel long distances. Hand mixing is most important when constructing floors, sidewalks and pavements in a natural gravel foundation where it is possible to shovel material directly upon the mixing board, mix and then shovel into place upon the opposite side.

Under no circumstances can machine mixing compare in cost with this method where conditions will permit of its use.

Mixing of Concrete.

For the ordinary work concrete should be mixed wet

—soupy. With regard to quality, ease of handling and manipulation, resulting finish and cost of surfaces, there is absolutely no question as to this point. This method of wet concrete applies to walls, bridges, reinforced concrete buildings, etc., but for sidewalks and pavements economy demands a dry mixture requiring tamping, in order that the workmen applying the finish may follow as quickly as possible after the deposit of the concrete.

Placing of Concrete.

No concrete should be placed until it is definitely determined that the forms are correctly placed and properly braced. It is cheaper to delay the work than to cut out work already done. Concrete should be placed as quickly as possible after mixing, and in its final location, not to be disturbed thereafter. Placing concrete is one matter neglected. We take great care of a green brick wall, but do not hesitate to walk over and conduct operations over concrete which has not reached its final set, thereby destroying the surface of the concrete for all time. While this may not be serious in some cases, it is certainly not desirable in thin concrete slabs. Concrete is better placed through chutes than by wheelbarrows, cars, etc., for the reason that by the chute method the material is constantly kept in the process of mixing until it is deposited in the work. By other methods the heavier particles settle to the bottom and when the mixture is dumped into the work there is a separation. Chute methods also allow the placing of the concrete with the least working back and forth over the work just completed.

The ideal condition would be in the completion of work without interruption, but as this cannot be done care should be taken in the location and manner of construction of the connecting joints as the work progresses. Breaks should preferably be made at the centers of slab spans and at the centers of girders, or over the centers of columns, transverse with girders. Slab spans may be joined longitudinally over the centers of girders or beams, but this method should be considered a second choice. Columns should not be poured all at one time. Generally four feet of concrete should be allowed three or four hours in which to set before the second pouring. Slabs, girders and beams should be poured continuously up to the determined joint where stop forms have been placed. The method of pouring girders up to the bottom of the slab and then afterward placing the slab is not desirable. The method of pouring a slab and allowing the material to slope down over the girder and then beginning the next day gives a slip slab joint which cannot be recommended.

In all concrete work stops should be made on horizontal and perpendicular lines at locations mentioned, the forms being carefully placed.

Finish of Concrete.

The surface finish of a piece of concrete should be an integral part of the main construction and of the same mixture and some composition. Time was when we were called upon to plaster and apply a surface coat to vertical surfaces. After a good many years of argument by the practical concrete workman we have reached a point where such surfaces are generally finished by spading so as to bring the finer particles to the surface and force the large particles back so they are not exposed.

We are, however, in a rut following the same old practice so far as horizontal surfaces are concerned, applying, as we do, a thin coating of a rich mixture on top of our cheaper concrete base. In order to secure the best results we should so manipulate our concrete as to bring our finish to the surface from the material of the concrete base. When we reach this point we will have less trouble with checking, insufficient bond, and so on, and such a method can be easily followed by the use of proper tools for tamping.

Construction of Forms and Centers.

If there is one element entering into the cost of concrete which is neglected, it is the cost of forms and centers. So far as is known to the writer, no architect or engineer ever submits to a bidder a plan for this part of the construction. Even the specifications are vague and indefinite, leaving it to the individual contractor to plan his own work. Some go to the extreme and use a great deal more timber than is necessary; others to the other extreme and use so little and of such light construction that the work is out of line and out of plumb. When it is considered that the cost of forms and centers represents from 20 per cent to 33 1-3 per cent in the cost of every cubic yard of concrete placed, under average conditions, it is hard to understand why the subject is not given more consideration. Ordinarily it is left to the carpenter boss to put up something by rule of thumb and by his judgment, based on past experience.

There is nothing practical about such practice. The designs for the forms of any structure should be carefully planned and designed to accomplish the results with a minimum of material and labor, giving due consideration to the maximum of salvage in the material. It is our contention that accompanying plans for any structure there should be prepared by the engineer and architect a sheet detail drawing showing how forms should be constructed, thereby insuring quality of workmanship and placing all bidders upon the same basis. If this is done, there is nothing to hinder any contractor from submitting an alternate design.

Types of Reinforcement.

Types of reinforcement now on the market may be listed as follows:

1. Plain bars, either medium or high carbon steel.
2. Plain bars, deformed or cold worked to secure deformation.*
3. Special patented types of plain or deformed patented bars.
4. Built-up bars, meaning thereby combination of various sized members in order to utilize the quantity of steel to the best advantage.
5. Built-up frames composed of bars of various sizes. Generally used for beams, girders and columns.
6. Floor slab reinforcement of sheet metal, sheared, punched and expanded in order to distribute the steel through the mass and delivered in sheets.
7. Cold wire, similar to fencing material, delivered in rolls.
8. Secondary reinforcement in the way of hoops or bands for columns, stirrups for beams and spacers for rods, all of which may be made of hoop iron or wire.

Selection of Reinforcement.

Considering the various types just mentioned and the many modifications now on the market, it is a difficult proposition to select the best, and generally the selection is determined by the price submitted by the commercial engineers bidding under a sub-contract. To a certain extent this method is dangerous, but it is hard to suggest a remedy. Individual preference and experience is always a very large element. We well remember a contractor who used solid concrete slabs six inches thick, reinforced with three-inch No. 10 expanded metal throughout the construction of the entire building, regardless of varying spans and varying loads, his reason being that such a construction always had proved satisfactory, and that it always rang true with a clear ringing sound when struck with a jauncing bar, and therefore there could be no question as to the integrity of the construction.

Placing Reinforcement.

The design of a concrete structure contemplates the

*Note.—This classification includes cold twisted and hot twisted square bars.

placing of the reinforcement in exactly the position shown by the plans and cross sections of the various members. The relative strength of any member acting as a floor slab, beam or girder is as the square of the effective depth. The stiffness or ability to withstand the load within deflection is relatively as the cube of the depth. Suppose that in any such construction the effective depth of the steel in the beam is ten inches, giving us 100 as the relative strength and 1,000 as the relative stiffness when arbitrarily compared with any other beam of like span. If, by careless placing of the steel reinforcement the effective depth is reduced, say, eight inches, we have for strength a relative value of 64 per cent and a relative stiffness of 51 per cent. This is a somewhat crude statement, but illustrates how careless handling of steel may destroy the most important design. Designers are usually quite conservative in their allowance for the protection of steel by fireproofing concrete below it and the contractor might better err on the safe side and take advantage of this allowance rather than to keep above it. Many times reinforcement, and especially light bars, expanded metal and wire fabric are laid upon the forms and then afterward manipulated by a hook as the concrete is placed, jerking the reinforcement upward so that the concrete may flow underneath. This is dangerous, inasmuch as there is no gauge to determine the final position of the reinforcement, and if the concrete flows under the reinforcement in too large a quantity it is almost impossible to replace the reinforcement without rebuilding the entire work.

Automatic spacers and devices for accurate placing of steel are readily obtainable and should be used. Naturally there is some increase of cost due to such methods, but it is a cost well expended.

Especial care should be taken to place steel in girders and beams so as to distribute and arrange the bars that each individual part may be incorporated within an individual part of the concrete. The reinforcement for columns should be accurately made and wired with the hoops and stirrups in place before they are erected in place ready to build the column forms around them. While good results can be secured with bar reinforcements, the author is at this time in favor of built-up columns of light structural shapes, for the reason that the integrity of the whole building depends upon the column construction and a failure of any one column is likely to result in the failure of the entire building. Perhaps the most important feature of the reinforcement and proper placing is that concerned with the top reinforcement, or reverse flexure bars. No matter what the designer may have in mind in theory and how the bars are proportioned with reference to the main reinforcement at the center of the slab or beam, it is absolutely essential that these top bars be placed accurately and not disturbed thereafter. This is easier said than done. The main reinforcement is embedded in the solid concrete below the surface and is protected from disturbance.

The top reinforcement is close to the surface, where it is affected by the future operations, and also where the free ends project in case of a break at the joints in the progress of the work. These free ends, if jarred, will many times break the bond of the half bar extending into the work.

The placing of loose stirrups is a matter for very careful supervision and is one of the strong arguments for built-up sections wherein the stirrup shear members are rigidly connected.

Finally, the employment of an expert mechanic or steel worker at increased wages over common labor is justified by the importance of this part of the work.

Proportions of Concrete.

It is very usual to specify a 1:2 ½:5 or 1:3:6 mix on plain or monolithic concrete work and the usual specifications for reinforced concrete is one part cement, two parts sand and four parts gravel, although some specify a richer mixture for columns. Inasmuch as there still exists a general ignorance on this point whereby these specifications are understood as being 1:7½ or 1:9 or 1.6, respectively, it seems best that the specifications be read that a mortar be mixed of one part of cement to so many parts of sand, and this mortar then be mixed with so many parts of the aggregate or gravel.

The proportioning of concrete by the selection of material or by the determination of voids of the material available will not be considered in this paper, as it is a subject by itself. We cannot overlook the fact that in the practical proportioning of concrete good judgment is necessary to insure that the mixture closely approximates the specifications.

Strength.

The ideal mixture of concrete assumes that the aggregate and mortar are mixed in such a proportion that the most dense, solid, homogeneous mass is obtained. This result may be secured with expert engineering supervision, but in reality the good common sense of the expert concrete laborer may be depended upon.

The artisan who is accustomed to handling concrete can determine by the appearance of the concrete mixture and by working the mixture whether he is securing the best results, and after a long experience the author is inclined to say that he would just as soon trust a practical, common sense laborer's opinion as to base his work upon the report of a so-called expert engineer.

Cost of Concrete.

If a 1:2:6 mixture will give the necessary strength required in the construction, there is no necessity for specifying a 1:2:4 mixture, inasmuch as the first mixture will require approximately one barrel per cubic yard, while the latter will require one and one-half barrels, a difference of at least 50 cents per cubic yard in actual cost. Many times, for footings and monolithic work, three-fourths of a barrel per cubic yard of concrete is all that is necessary—a mix of one to eight.

Why specify a rich mixture when one with less cement will answer the purpose? If the contractor is at all skilled in estimating, such a cost will be included in his proposal.

Estimating.

No proposals should be made upon a concrete job until a proper analysis of all the elements entering into the concrete construction is made. It is not sufficient to say or to guess that the cost of a cubic yard is so much, but instead an analysis should be made of the cost of a cubic yard of concrete under the conditions specified. There are a great many elements entering into the cost determined by such an estimate. They are briefly stated in the paragraphs that follow:

Cost of Materials.

Whether or not the concrete is to be made of a natural mixture of gravel or of stone and sand in various proportions will depend the cost of the aggregate. The amount of cement depends upon the proportions of the concrete, as also does the gravel, stone and sand. Various tables have been published for these proportions, the best known being those prepared by Mr. Thatcher and that published in Taylor & Thompson's Concrete—Plain and Reinforced. The cost of water for proper manipulation should not be overlooked. In cities the cost of water is determined by rates of 9 or 10 cents per cubic yard. Outside of cities the cost depends upon the labor necessary to secure it.

Cost Affected by Locality.

Concrete work constructed at a remote distance from populous centers cannot be done at the same price as

that in cities, unless the work is so remote that a permanent camp can be constructed and the laborers held by the very remoteness of the work. Work that is some distance from the point of supply must bear a charge for transportation, handling and hauling of raw materials. This is a labor charge which is chargeable to material, inasmuch as the materials should be considered as f. o. b. the job, but nevertheless the cost is increased per cubic yard in the proposal.

Character of Labor and Work.

Good American labor will accomplish at least 50 per cent more per day than foreign labor. American labor, however, is scarce and preferential. American labor differentiates between clean-cut concrete work under favorable conditions and concrete work under adverse conditions, excessive water and other disadvantages. The same work may cost a great deal more when built under unfavorable conditions than when built in town.

Cost of Forms.

A wall of concrete twenty-seven feet thick may be retained by the same forms and the same amount of form labor as is necessary for a wall one foot thick. In the latter case the form cost per cubic yard of concrete is twenty-seven times as great as in the former. It is, therefore, not safe to estimate the cost of forms on a basis of guess price per cubic yard of concrete. Each individual job should be estimated for the amount of timber work as carefully as for any other item. It does not matter whether the cost is estimated on the basis of floor foot or concrete surface, or upon a basis of feet B. M. of lumber. The result is the same, inasmuch as this important branch of concrete construction receives individual consideration.

Cost of Centers.

There seems to be a misunderstanding as to the separation of forms and centers. Forms, properly speaking consist of the timber work to form those members of concrete construction, such as columns, girders, etc., which must possess a certain regularity of form and evenness of outline. Centers, properly speaking, consist of timber supports for floor slabs, bridge centers, etc.

Where the great amount of labor on timber work is expended solely for the purpose of supporting the mass at a uniform or definite height the unit cost is much less than for forming for individual members.

Fabricated reinforcement will cost much more delivered to the job than loose bars; but, on the other hand, will cost much less to place in position. It is useless to say that a job on which reinforcement is made up of bars smaller than ¾ inch will cost much more per ton for labor than for large sections. Good judgment must prevail in this particular. It is very seldom that an estimate will be made based on the labor and the tonnage of each size bar. Rather, it is the case to strike an average labor price in harmony with the class of work to be encountered with reference to the different sizes of reinforcement. It is well to remember, however, that

House for Mrs. E. R. Marvin, Pittsburgh, Pa. Janssen & Abbot, Architects.

it takes practically as long for the steel man to place and wire a ⅜-inch bar as a ¾-inch bar, whereas the tonnage is only one-fourth as great, and this point should be kept in mind in making an estimate.

General Charge Items.

There are a great many items of the cost of concrete work which are not included in the cost of material, labor, forms and centers, reinforcement, etc. These costs consist of installation of machinery and removing it, coal, oil, repairs and fittings for machinery; general charge items, such as rope, bolts, etc., and the loss on petty tools, such as shovels. Such costs may be determined on the basis of so much per cubic yard, or preferably they may be determined on the percentage of labor on different classes of work. No matter what the method of determination, the costs are really true and are justly chargeable as for the gravel or cement entering into the work.

In line with the foregoing remarks and the importance of a detail study of concrete, we submit the estimate for a cubic yard of concrete which, according to specifications, should be of a 1:2:4 mixture, to be used for the purpose of building construction and, making these estimates, we desire to lay emphasis on the fact that no two jobs cost the same when itemized in this way.

.9 cubic yards gravel at $1.20	$1.08
.45 cubic yards sand at $1.00	.45
1½ barrels of cement at $1.20	1.80
Water	.10
200 feet B. M. of lumber at $20.00 (used four times at 20 per cent less each time used, less 40 per cent salvage	1.08
Reinforcement, 150 lbs., per cubic yard, at 2½c	3.75
Total cost of material	$8.26
Labor concrete	2.00
Labor forms, 80 feet B. M., at $30.00	2.40
Labor centers, 120 feet, at $20.00	2.40
Labor reinforcement, 150 lbs., at 1½c	.75
Total labor	$7.55
General charge items proportion of labor 15 per cent	$ 1.13
Total actual cost one cubic yard concrete	16.94

Each individual job that is encountered should be estimated in this way. It might not be necessary to throw the cost of forms and centers, reinforcement, etc., into the cost per cubic yard of concrete, but, however the estimate is made it should consider all these items and in the end the result will be the same. If, in addition, there is to be applied a surface coat or finish of exterior surface the cost of this must be added.

If there is any one item which adds to the cost, it is the form and center work. For instance, in the detail estimate just given cost of lumber and form and center labor is $5.88. If the work had been twice as heavy the cost of this labor would have been only half as much per cubic yard. This should bring home to every estimator the importance of dealing with a temporary structural timber work as a separate unit. Personally, the writer would rather guess at the amount of reinforcement per cubic yard than to guess at the cost of forms and centers.

The cost of labor is dependent upon the amount of concrete placed on a square foot of the area of work covered, inasmuch as the cost of placing depends upon the distance traveled and the amount handled. The greater the distance, the less the quantity and the more cost per unit, and the less the haul the greater the mass and the less the cost per unit.

Such labor cost may reach anywhere from $5 to $50 a yard, and it is suggested that a careful study be given each job to determine the amount of foot pounds of work necessary to complete it.

Cost Records.

It is suggested and recommended that each separate and distinct job should be given a detailed cost record, in order that future work may be properly estimated. It is a very simple matter to arrange a cost record book with a system of time reports so that such records may be obtained and recorded without increase in labor or cost.

Concrete Surfaces.

We have now reached a point where a proper recognition has been given to concrete as an ornamental finish. In the majority of cases, on the exterior the concrete will be masked by brick, stone or terra cotta. Concrete is a better wearing material, capable of just as much ornamental treatment as other materials and such masking is obtained at an increased cost. Almost any design or reliefs in the way of ornamentation, etc., can be accomplished in the material, with any combination of color or texture of surface; also, if necessary, with paneling in color tiles or mosaic.

On the interior, plain work is disgraced by plastering, and, if necessary, results may be obtained in the same manner as for the exterior. Such surfaces cannot be obtained at the usual price for concrete work, but they can be obtained at less cost than for the addition of other materials which are used simply for the purpose of masking the rough concrete.

LUNKENHEIMER CAST STEEL VALVES.

Superheat and high steam pressures have created a demand for valves of greater strength and durability than those made of cast iron. Always anticipating the requirements of the trade, the Lunkenheimer Company has designed a complete line of Globe, Angle, Cross, Gate, Check, Non-return Boiler Stop, etc., made of Cast Steel, all of which will be found in actual use, and giving perfect satisfaction in a large number of high pressure power plants.

With the exception of the largest sizes, the Lunkenheimer Cast Steel Valves are made of Crucible Steel and not Open Hearth or Converter Steel.

Crucible Steel is made and melted in closed crucibles, out of all exposure to furnace gases, and solid castings free from blow-holes are insured.

This is not true of the Open Hearth and Converter Steels, the first of which is heated by blowing hot gases over the molten metal, and the second by blowing them sometimes through the metal. Aside from forming blow-holes these gases form oxides, which dissolve in the steel and thereby reduce its ductility and cause a low elastic limit.

All of Lunkenheimer Cast Steel Valves are annealed, which relieves all internal stresses and makes a fine crystalline structure, which is very essential to strong steel.

The Lunkenheimer Company claim that their valves are the only ones which are made to meet the specifications of the American Sociey for Testing Materials, and that they are the only steel valves containing less than .05 percent of either phosphorus or sulphur.

The tensile strength of Lunkenheimer Cast Steel is about 80,000 pounds per square inch, with a safe elastic limit and excellent elongation.

For various pressures and degrees of superheat and to meet the requirements of engineers who differ as to the material used, Lunkenheimer Cast Steel Valves are made in two combinations of material as regards the trimmings.

For lower pressures and degrees of superheat, the company manufactures a large and complete line of Cast Iron and "Puddled" Semi-steel Valves.

The Lunkenheimer Company, who are the largest manufacturers of high grade engineering specialties in the world, and have their plant and general offices located in Cincinnati, Ohio, will send descriptive matter pertaining to their Cast Steel Valves to any one interested.

NEW AETNA CEMENT MILL.

The worst fire that has visited Fenton, (Mich.) in years broke out in the engine room of the New Aetna Cement company's building recently, damaging the structure and throwing 200 men out of employment.

Night Watchman Charles Peetrick discovered the blaze and before he could summon help from the city, two miles from the plant, the fire had gained great headway and could not be checked until the engine room, containing valuable machinery and other apparatus, was destroyed.

The plant has been shut down for the past week and it is not known how the blaze started, as no fire is kept in the furnace, electric power being used. The loss is covered by insurance.

A Large Drainage Project

One of the largest drainage projects in the country is that being carried on in the Everglades of Florida by the Furst-Clark Construction Company of Baltimore. The accompanying picture shows the Miami at work, a 2½-yard Marion dredge, which was converted into a clam shell.

The magnitude of this project may be gathered from the following report recently made to the trustees and placed on record:

"The canals being excavated under this contract are the Hillsborough, having its outlet through the Hillsborough River, the North New River and the South New River, having their outlets through New River, and the Miami, having its outlet through the Miami River. In addition to the above-named canals the canal connecting Lake Okeechobee with the Caloosahatchee River to the Gulf of Mexico has been deepened, widened and in some places straightened.

"The Hillsborough, North New River, South New River and Miami canals flow from Lake Okeechobee to the east and southeast and have their ultimate outlets in the Atlantic ocean. Each of the above canals are being constructed 60 feet wide and at a depth of from 8 to 10 feet.

"This work was first begun in the spring of 1906 by the state, through the trustees and the board of drainage commissioners, with one dredge. Some months later another dredge was added to the work, and in the spring of 1909 two more dredges were added, making a total of four dredges being operated in 1909.

"The work from the time of its inception by the state had been greatly hampered for the lack of funds with which to operate, the legislature having enacted a drainage law establishing a drainage district and providing for a drainage tax, the constitutionality of which was at once attacked by owners of large bodies of land in the drainage area, causing a siege of litigation and preventing the collection and use of the drainage tax, resulting in the work having to be carried on by means of funds derived solely from the sale of lands, the principal portion of which were in the Everglades, and which were then but little in demand, and when sales could be made the price per acre secured was small.

"In the spring of 1910 a settlement or an agreement was reached by the trustees and the litigating land owners by which the suits were withdrawn, the litigants agreeing to pay the drainage taxes, and parties owing large sums of money to the trustees, a great deal of which was not payable for a number of years, agreed to advance the time of the payment of these sums due, and as a result the means were available as needed, and it was decided to let the work to contract, with a view to hastening the completion of the work.

"A contract was accordingly let in June, 1910, to the Furst-Clark Construction Company of Baltimore, Md., for the completion of the work, approximating the cutting of 175 miles of canal, enumerated in this article, to be completed by the 1st day of July, 1913, about 29.08 miles having already been cut by the state.

Furst-Clark Construction Company's Marion Dredge at Work in the Everglades of Florida.

"The original total length of the canals was 213.08 miles, distributed as follows:

Hillsborough, miles	46.50
North New River, miles	57.65
South New River, miles	70.80
Miami (connecting with South New River), miles	28.50
Total	203.45

"Of this amount the state had cut prior to letting the contract to the Furst-Clark Company 29.08 miles. Said company has constructed, up to November 1, 1911, 75.90 miles, distributed among the following canals:

Hillsborough, miles	10.86
North New River, miles	35.32
South New River, miles	11.45
Miami (connecting with South New River), miles	18.27
Total	75.90

"It will thus be seen that the contractors have constructed 75.90 miles of canal since they began work. The amount of work done by them the first six months was far below the average required to complete the contract on time, some time being required to assemble proper equipment. They started with only four dredges, but have from time to time added to their equipment, until they now have a fleet of nine dredges engaged in the work.

"It was estimated at the time of letting the contract that the total excavation would amount to 19,013,490 cubic yards of material of all kinds. Up to the first of last month there had been excavated a total of 6,848,112 cubic yards of material, being 36.01 per cent of the entire work. But the work done last month was 654,590 cubic yards, 5.63 per cent of the remaining yardage to be cut, and as there are still 19 months remaining of the contract, and one of the nine dredges now engaged upon the work only began work the first of the month, the completion of the work being upon contract time, July 1, 1913, would seem to be assured.

"In addition to the above work, a contract has been let for the deepening and widening of Cypress, Snake and Snapper creeks, natural water courses, flowing easterly and southeasterly out of the Everglades into the Atlantic ocean, conditioned upon securing a right-of-way to same.

"A tentative proposition has also been entered into and surveys of several routes made for adoption of the most practicable route for a canal from the east side of Lake Okeechobee, with its outlet in Lake Worth, near West Palm Beach.

"The trustees of the internal improvement fund and the board of drainage commissioners have funds in hand and available for the completion of the contracts made, and in addition have a sufficiency of lands, together with the drainage tax being collected, to construct such other canals as conditions may warrant.

"Two surveying corps are now in the field engaged in establishing township and range lines and locating section corners in the Everglades. This work is being pushed to completion as rapidly as conditions will justify."—Steam Shovel and Dredge.

REINFORCED CONCRETE TIES.

The Universal Concrete Tie Company, which has now organized and opened its office in New Orleans, will manufacture the Percival concrete tie. While recognizing the necessity for a substitute for wood ties, the fundamental objection to the concrete tie is its want of resiliency. This criticism, however, is to some extent overcome in the construction and use of the Percival reinforced concrete tie which cushions the load. Four to six years' use of these ties under heavy traffic conditions in various trunk lines has furnished much data on this problem.

These ties are reinforced by deformed steel bars, so tied together as to form a truss. They are moulded in specially designed moulds, and thoroughly matured before used, and with proper care in selecting and mixing the ingredients, permanency is assured. The rounded edges of the base of these ties minimizes the weight and eliminates breakage of unprotected edges in handling, while the "V" shaped centers of base insure solidity in track, overcomes the vibration of motion, prevents sliding or slewing of track and entirely eliminates center binding so common in all other ties.

These ties can be made at points along the track where needed, thus obviating handling except on push cars, and by common labor of the section, when not otherwise employed; but always under proper supervision.

The weight of ties varies according to size: i. e., from 375 lbs. for ordinary roadbeds, to 450 lbs. for heaviest traffic conditions under trunk lines, while in terminals and grade crossings larger are used, and owing to their greater bed and face area. 2,600 of these ties will replace 3,000 wood ties to the mile under maximum traffic conditions.

Experience under varying traffic conditions has proven that rails on these ties always remain true to gauge, and that the track cannot spread since spiking device does not work loose.

This spiking device consists of a bolt of varying lengths and diameter, according to its uses, which enters a reinforced non-corrosive socket imbedded into the concrete, and is suitable for all kinds of cement construction, such as buildings, viaducts, street railways, etc., and can be supplied by this company in any quantity.

Marion Steam Shovel Loading Dump Cars on W. Z. Williams & Company's Contract Near Macon, Ga.

EDWIN C. GRIFFIN.

Edwin C. Griffin, inventor and manufacturer of cement grinding machinery, died on December 10, 1911, in Boston. Mr. Griffin, who was a native of Ontario, Canada, was born January 29, 1848. Owing to the importance of his inventions, chief among them the Griffin mill, he was as well known in the cement industry, both at home and abroad, as one of the leading manufacturers of cement. Mr. Griffin was a son of the late James K. Griffin, inventor of the original single roll mill that bore his name. The father died about a year ago at the advanced age of ninety years.

As stated, the family has long been identified with the cement industry. The early single roll Griffin mill was invented by the elder Griffin. Its first use was in connection with grinding phosphate rock, and the first time its possibilities for clinker grinding were considered when it was inspected by John W. Eckert and Robert W. Lesley, of the American Cement Company, who saw it in operation in a fertilizer works near Boston. They were so much impressed with the success of the mill as a grinding machine that they at once ordered one, which was installed at the plant of the American Cement Company at Egypt, Lehigh county, Pennsylvania. This mill required all sorts of attention and all kinds of changes before it was finally perfected for the grinding of clinker; but from this small beginning the great growth in the cement industry arose. Edwin C. Griffin, who was the active man of the Bradley Fertilizer Company—the concern which then owned the patents—was largely instrumental in perfecting the mill. For the past twenty years he devoted his time and energy to the development of the Griffin mill, making many improvements, keeping it prominently before the industry in this country and also aiding in its introduction abroad.

Aside from the success that attended the manufacture of thoroughly reliable and excellent machinery, Mr. Griffin personally enjoyed the esteem and friendship of all who knew him. He had an extensive acquaintance in engineering and scientific circles as well as among those representing the manufacturing side of the cement industry. His pleasing personality, high character and integrity combined to make him a conspicuous figure in industrial and commercial fields, and the announcement of his death was received with deepest regret by his many friends.

TWENTIETH CENTURY LONG-HANDLED CONCRETE TOOLS.

Modern times demand modern methods. It cannot be expected that a man today can compete with others in his line unless he employs methods that are up-to-date.

The sidewalk man of yesterday was compelled to endure back-breaking work—work that could be accomplished, were modern methods employed, in one-fifth the time. Yesterday's methods, however, are not adaptable for today. The sidewalk man of today, equipped with long-handled finishing tools for his work, can accomplish in two hours, and it is claimed, with far better results, what the man of yesterday would require ten hours to accomplish.

The 20th Century long-handled concrete finishing tools are the result of much study on the part of a practical sidewalk man. The complete set consists of a 24-inch trowel, an edger, a jointer and a marker. All tools are equipped with a link connection, between the handle and the blade, which automatically adjusts the blade to the surface, raising the edge slightly, to prevent digging into the concrete—this irrespectively of whether the tool is being pushed or pulled—and at the same time giving the tool the same wrist motion that is given in hand work. There is no need to raise or lower the handle and no need to twist it—just a straight push and a straight pull. All of the work may be done from one side of the walk, and the handle may be set at any angle, thus accommodating itself to a tall or short operator and enabling him to finish around a tree or post. Nothing but the very best of material enters into the construction of these tools, and they should last indefinitely. The 20th Century Mfg. Co. are located at 1661 Lowell Avenue, Chicago Heights, Illinois, and have a splendidly equipped factory. They will be pleased to forward you, upon request, descriptive literature of their products.

WABASH PORTLAND CEMENT COMPANY'S EXHIBIT.

At the Cement Show, which was held at the Coliseum, Chicago, last month, the Wabash Portland Cement Company's exhibit displayed a distinctive class of ornamental concrete made from their Wabash Portland Cement and Granite Crystals. It demonstrated the adaptability of concrete for ornamental work and its beauty attracted much attention. Architects and others familiar with high-class work were lavish in their praise and frankly declared it to be the best concrete exhibit ever shown because of its perfect uniformity of color and practicability for use in modern building. In other words, it joined hand in hand beauty and durability.

The Wabash Portland Cement Co. are certainly to be complimented for supplying such a pleasing demonstration of the superior merits of their product by furnishing something which was no imitation in any sense of the word. More beautiful than stone distinctive in its class because it can be produced only in concrete form.

LARGE ORDERS FOR LEHIGH CEMENT.

The Ohio River Contract Company, speaking of its work during the past year, says:

"During 1911 our principal work was completing repairs to dam No. 13, Ohio River (2,500 barrels of Lehigh cement); excavating rock from Kentucky River at lock No. 11, Kentucky, and dredging in the Ohio River for the government. In this year also we were awarded the contracts for constructing the largest movable dam in the world, lock and dam No. 48, Ohio River, and for constructing lock No. 41, Ohio River, together with widening the Louisville canal at Louisville, Ky. During December, 1911, we placed an order with the Lehigh Portland Cement Company for 125,000 barrels of cement, delivery to extend over four years. We are adding nineteen additional pieces to our floating plant, all for spring and summer, 1912, delivery; for the winter of this year we have under contemplation the erection of another large dipper dredge. In 1911 we purchased two Brownhoist locomotive cranes. At present we are in the market for gasoline boats."

MECHANICAL WIRE TYING OF REINFORCING STEEL AND BAGS.

At the recent Chicago Cement Show there was exhibited a most interesting device which has made a great record for itself in a very short time in labor saving and other efficiencies in concrete construction work and for tying Cement Bags. Until this device came on the market all contractors in binding their reinforcing rods had a great deal of difficulty, with labor, costs, etc., in attempting to tie intersections of the rods together to

Method of Tying.

prevent their slipping. They were forced to use a pair of pliers and to cut the wire into lengths convenient for their men who did the work. The method was elemental, rather slow, and also developed a very unstable human element, all of which difficulties we think are overcome

Showing Bag Tied.

by the ingenious device shown herewith, known as the "United Tyer."

An examination of the illustrations will show that this is a simple and practical device. It has been found in actual experience on a great many reinforcing jobs that the cheapest laborer with a few minutes' practice can tie from two to three times faster than a much higher priced man with pliers. This means, of course, a great labor saving.

Another most interesting point is that the ties used for the binding are uniform in length and the mechanical action of the tying tools, giving the wire a uniform number of twists, make it tight and secure. As every contractor knows it is physically impossible for a man to tie with uniform tightness with pliers. He will not twist the wire as tight as he should and consequently the rods slip and get out of place. This is not possible with this tyer, for the man cannot help making an absolutely perfect tie if he makes any tie at all.

A third interesting point is that it can be taught to green men in a very few moments, requiring no skilled laborer whatever, as the operation is extremely simple and rapid.

Practical experience with many contractors has shown that in cold weather or even in very hot weather tying with pliers is slow, particularly in the former case, on account of the numbness of the men's hands. They will not tie rapidly nor securely under these conditions. There is little movement of the hands required in the operation of the United Tyer and many contractors report that they are using it under the most difficult conditions.

This system of tying is now being used by a great many contractors, as well as cement and lime manufacturers for tying bags. Further information, prices, booklets, etc., can be obtained from the United Wire Tie Company, Department C, 220 Nicholas Building, Toledo, Ohio.

LIQUID MARBLE.

Liquid Marble is an interior, air-drying enamel or finish for concrete, plaster, wood, wallboard, brick, and metal. Applied with a brush, it will dry hard in a few hours, look like marble, will get hard like marble; is durable, sanitary, fireproof, and costs but little.

Liquid Marble can be applied flat finish or with a porcelain gloss; it is naturally white, but can be made in colors; it can be made at from 25 to 35 cents per gallon. No machinery is required, and it can be mixed on the job as used, if preferred. One gallon liquid marble will cover 80 to 100 sq. ft. on concrete or plaster, 150 sq. ft. on wood, wallboard and metal, and will finish 50 sq. ft. on wood floor over burlap.

Applied to cement or composition floor, Liquid Marble will prevent dusting, and give any desired color. On wood floor, it will give a fine marbleized finish at a cost, it is claimed, below that of any other floor covering. Liquid Marble contains no casein, wax, oil, or vegetable or animal matter, and will not crack, dust, or mildew. This is said to be the only marble finish that can be applied to floors with a brush; it is suitable for office, barber shop, kitchen, bathroom, dining room, porch floor, basement, and garage. It can be applied to metal, clay, and concrete vases, tubs, vats, vaults, etc., and will imitate marble or porcelain, and is cheaper than paint. Its sale and application offer a permanent business.

The formulas, instructions for use, and the right to use and sell the Liquid Marble will be sold to one reliable, energetic person in each town, township, or city, and this person will be protected and assisted in his territory in the sale and use of the material.

For price and terms, specify territory wanted, give reference, and address E. R. Stowell, Portland, Ind.

MATERIALS FOR WHITE PORTLAND CEMENT NEAR CHATTANOOGA.

By William M. Hunley.

Everyone is more or less familiar with the appearance of Portland cement. As is well known, it is gray in color and, while it is suitable for every sort of structural work, it is not well adapted, on account of its color, for ornamental and decorative purposes. A cement which would meet the latter requirements might be expected to find a large demand.

White, non-staining Portland cement does this, and is one of the newer developments in cement manufacture. Three or four brands are now being made in the United States, principally to supply the demand for ornamental work and surface finish, as a material for making handsome mantels, friezes, statuary, arms, seats, sculptural work, etc. The white cement is finding successful application, and by careful manufacture it can be made to pass most of the standard specifications for ordinary gray Portland cement. It is not, however, used very much as a structural cement, but rather for ornamental purposes, and for this reason it is not necessary that it should have as great strength as the gray variety.

Raw materials suitable for making the white cement are not widely distributed, and must be selected with great care. The silica and alumina in them must be properly proportioned and the iron oxide must be under 1 per cent, and nearer nil the better. Therefore, limestone and clay which are low in iron oxide, or, better still, free from it altogether, are necessary for the manufacture of colorless cement.

In view of the scarcity of the raw materials suitable for the manufacture of white Portland cement there are very few mills producing it, and consequently the supply and use are more or less restricted. In view of these conditions, the cost per barrel of white cement is considerably higher than that of the ordinary gray variety. It would undoubtedly be manufactured on a much larger scale if it were known where to find the suitable raw materials in sufficient quantity.

Dr. T. Poole Maynard, a well-known geologist of Atlanta, is of the opinion that suitable materials for the manufacture of white Portland cement occur in the Chattanooga district in great abundance. In regard to this he says:

"The Chattanooga district occupies an area underlain by rocks which were deposited in water, and these rocks consist essentially of sandstones, limestones and shales. The limestones and shales occupy the valleys and low ridges, and extend well up on the flanks of the mountains, while the sandstones and shales of the coal measures form the escarpments of the mountains and occupy the broad table lands of the great Cumberland plateau.

"The geologist, after acquiring a thorough knowledge of the conditions which prevailed when these rocks were deposited, and knowing the association of rocks and minerals, one with the other, can anticipate without much speculation what careful search should reveal.

"The materials from which white Portland cement are manufactured consist of the same constituents as those which constitute a gray Portland cement, with the exception of the content of iron.

"The calcareous materials in the Chattanooga district are contained in the limestone of the Chickamauga formation of Ordovician age and the Bangor limestones of Mississippian or Lower Carboniferous age. The Chickamauga limestones are not only shale, or clayey, but the great variation in the physical and chemical character of the beds is evidence to the geologist that these limestones were deposited in fairly shallow waters, so that they were contaminated, so to speak, by muds brought into the sea by rivers. The geologist would, therefore, not expect to find in this formation limestones which would approach a theoretically pure high calcium stone. It would be useless, therefore, to search in this formation for limestones with the prescribed content of iron oxide.

"A study of the Bangor limestone in the field with regard to its physical character, fauna, thickness and its relation to both underlying and overlaying formations gives evidence of the fact that these limestones were deposited in a sea comparatively deep, some distance from the shore line and free from the contaminating influences of land-derived materials brought down by rivers.

"The fact that these limestones reach a thickness of 900 feet and are so uniform in their physical character that it is often difficult to distinguish the beds except by their fossil content, fish roelike and crystalline character leads the geologist to expect that certain beds may be found in this formation approaching very closely a pure calcium carbonate.

"A chemical study of the different beds reveals the fact that two general types of calcareous materials found in the Bangor limestones, which occur at higher elevations than the Chickamauga limestones, are, first, beds of very high calcium limestone, massive in appearance, made up largely of the remains of fossils and largely crystalline; and, second, magnesian limestones, fine-grained, massive and heavy bedded, breaking with a conchoidal fracture. The high calcium beds usually carry less than one-half of 1 per cent of iron oxide, and many of the beds run as low as 0.14 and 0.18 per cent. The important fact is that these beds occur over sufficient thickness to make them attractive commercially in the manufacture of a white Portland cement.

"Naturally there are many other factors to be taken into consideration in the location of a mill for the manufacture of white cement, such as the source of fuel, power, clays free of iron, water, transportation facilities and markets. Transportation facilities are adequate in this district, so that oil for the burning process and white clays free from iron could be secured, in all probability, as cheap, if not cheaper, than in any other locality in this part of the country. White Portland cement commands a much higher price than the gray cement, and consequently the greater cost of manufacture is justified. The market would be all that could be desired. White Portland cement is not produced in a mill in the South today. This is a most promising field."

PORTLAND CONCRETE PILE COMPANY OPENS SAN FRANCISCO OFFICES.

The Portland Concrete Pile and Equipment Company, which has established permanent offices at 754 Phelan building, San Francisco, is the patentee and sole owner of the "Portland" concrete pile, the modern method of installing foundations.

The company has a corps of engineers of wide experience in concrete foundation work, and maintains its head office at Portland, Ore. Branches are established at Seattle, Wash.; Houston, Texas; Baltimore, Md.; Vancouver, B. C., and San Francisco, Cal.

The engineers of the Portland Concrete Pile and Equipment Company, realizing the need of a concrete pile that would meet all the requirements as to economy of labor, time and placing; also the defects of the present systems in use, started in 1907 placing Portland concrete piles.

The Portland concrete pile, aided as it was by its organization, composed of specialists experienced in designing and placing every kind of foundation, office buildings, warehouse, bridges, retaining walls, docks, seawalls, bulkheads and all kinds of concrete structures, both plain and reinforced, at once proved its efficiency and was ac-

cepted by the leading architects, engineers and builders.

For concrete piling in general, and for the Portland concrete pile in particular, the following claims are made and can be substantiated:

First—A concrete pile is as durable as rock.

Second—Due to the tapering form of the Portland concrete pile and the fact that the green concrete comes in direct contact with the compressed earth surrounding it, the Portland concrete pile securely bonds itself with the surrounding earth and will sustain a greater load than other piling. The compressed earth is permanently hardened (chemicalized) by the surplus water passing off into the surrounding earth.

Third—Concrete piles insure absolute durability, absolute immunity from the attack of the teredo, electrolysis and the inroads of the animal and vegetable life.

Fourth—Rapidity of construction. No deep excavations for walls and footings, because it is not necessary to keep the heads of the concrete piling below low water line.

Fifth—First cost of concrete piles will be much less than masonry or concrete piers, with as great a supporting power; no secondary cost, as they are permanent; no sawing off of piles, as they can be made of uniform height when green, thus maintaining a top alignment.

Sixth—This system of concrete piling, due to the use of a collapsible former, is the most economical, sure and rapid method of foundation, building in loose or filled-in localities that have been developed.

Seventh—This system has the hearty endorsement of those engineers, architects, owners and builders who have had experience with it.

The Portland Concrete Pile and Equipment Company drive two types of piles. The moulded pile, reinforced and cured for thirty days, is driven like an ordinary wood pile. That it will stand rough treatment is proven by its work on the Broadway bridge at Portland, where one of these piles, driven with a stroke of 9,000 foot pounds, was hit 72 blows a minute for 58 minutes, without shattering. In other words, it stood 37,584,000 foot pounds impact without any signs of wear.

The other type is the made-in-place pile. The former, composed of a core and shell, is driven to penetration required or to refusal. The core is then attached to the hammer and withdrawn with it to the leads.

If the pile has been driven in fairly stable ground, the shell is filled with concrete to three or four feet above the ground and the shell withdrawn, the concrete settling into place. If the piles are to be reinforced, the reinforcing steel is placed before the shell is completely filled.

When the piles are placed in unstable ground, or where water exists, and a heavy back pressure is encountered, a bottom dump-bucket is used, the concrete being placed, a bucketful at a time, and rammed into place, the shell being withdrawn a few feet at a time. By means of the rammed concrete, a perfect bond is obtained between the earth and the concrete.

In the last eighteen months the Portland Concrete Pile and Equipment Company have driven, if placed end to end, twenty-five miles of Portland concrete piles, on $4,000,000 worth of work.

CEMENT TILE.

The Worthington (Minn.) Globe recently published a photo showing a special train load of cement tile consisting of 60 cars. The tile was made by the Sac City Cement Pipe Co., Sac City, Iowa. In the entire shipment, 19 tile were broken, 12 of which were caused by inexperienced handling when unloading the special train. Cement tile is becoming more and more famous for its excellent quality and superiority over other tile. The Worthington Tile factory has tile of equal quality to that shipped in cars, and are turning out nothing but the highest quality of goods.

CONCRETE CULVERT COMPANY.

The Kansas Construction Co., Murdock Bldg., Wichita, Kan., recently organized are building a factory building where they will manufacture reinforced concrete culverts and sewer pipes. The Nebraska City Company (Neb.) with which this company is allied, has five other plants in operation in Iowa and Nebraska. It is not a new industry, but is new to Wichita. The company has two large boats and it will ship sand in connection with its concrete sewer pipe and concrete bridge business.

DEATH OF PROMINENT CEMENT MANUFACTURER.

It was with extreme regret that we observed the death of Mr. David D. Drummond announced in the Chicago press of March 9th.

Mr. Drummond was one of the early cement manufacturers in the middle west, his connection with the Chicago Portland Cement Company, of which he was latterly vice-president and manager, dating back fully 13 years.

An enthusiastic and untiring worker, Mr. Drummond

The Late David D. Drummond.

was always a prominent figure at the meetings of the Association of American Portland Cement Manufacturers and during his entire lifetime he was likewise actively interested in the work of the National Association of Cement Users and kindred bodies.

Born in Scotland, Mr. Drummond lived in this country since boyhood. He died in his fifty-second year and is survived by a widow and three sons, Douglas, Ralph and Kenneth.

NEW ORDERS.

Sandusky Portland Cement Company informs us that they have just received an order for 100,000 pounds of Medusa Waterproofing for use in the New York Dock Company's job at Atlantic Basin, Brooklyn; 5,000 barrels Medusa Waterproofed white Portland cement for use in the Woolworth building, New York City; 25,000 barrels of Medusa gray cement for use in the Central High School building, Minneapolis, and 3,000 barrels of Medusa white Portland cement for use in the same building.

SAND SIFTING MACHINE.

One of the most up-to-date and thorough machines that have been put on the market for a long time is the sand sifting machine shown in the accompanying cut.

This is apparently a very simple machine but it has taken several years to get it to its present state of perfection.

When the sand is thrown into the hopper a force feed takes it into the revolving cylinder which is hung on an inclined shaft. The sand goes through the screen, which forms the cylinder, and the gravel works out at the lower end.

With the old style slanting screen, if the sand is wet and sticky, your man throws many a shovelful of sand and gravel, that already has been handled several times.

Not so with the machine. You shovel the sand to the machine but once.

The finest feature of the machine is the tamping device which hits the screen four times for each revolution. The taps may be adjusted light or heavy, at will, or not used at all, depending upon the condition of the sand. The continual tapping cleans the screen, jarring loose any wet sand or clay sticking to it.

The frame is made of angle iron and well braced to withstand the rough usage accorded all machinery by the average laborer of today.

Screens are easily changed. Any size mesh can be used and the changing takes but a few minutes. It is easy to operate—a ten-year-old boy can turn it while the machine is running to its full capacity. It may also be operated by power.

Regarding capacity, the machine will handle six yards per hour easily in dry sand. In wet sand it takes a little longer, from four yards up, depending upon the condition of the sand.

Help is scarce everywhere, and wages are high. Contractors are ever on the watch for machinery that will save labor, save time and make good.

These things are claimed for the sifter and justly so. The manufacturers substantiate all claims and guarantee satisfaction. A catalogue will be mailed to you by addressing Cement & Engineering News, 1117 Schiller Bldg. Chicago.

NEW SAND-LIME BRICK PLANT IN HAVANA.

W. J. Carmichael, of the American Clay Machinery Company, Willoughby, Ohio, writes enthusiastically of a trip he recently took, and of some of the things he saw on the journey. He went from New York to Havana and took up the engineering proposition of a large plant to be erected there for the production of sand-lime brick.

One of the interesting features connected with the proposition is, that one of the members of that company traveled all over Europe and parts of the United States to select the best equipment and process for their work. Although the American Clay Machinery Company's prices were higher than those of some other companies, they received the order. Mr. Carmichael says their wet grinding mills have given most excellent results wherever installed, so that any party investigating the sand-lime-brick business cannot put in other machines for the work.

Since the recent convention in Grand Rapids this company has sold one of its large 16-mold rotary presses to the Harbour Brick Company, of Toronto, Canada, and another plant will be placed in Syracuse, New York, soon.

CALIFORNIA'S MINERAL PRODUCTION FOR 1910.

Former State Mineralogist Aubury has prepared a table showing the total mineral production of the State of California during 1910. The grand total, not including precious metals, was $67,879,789, or a gain over the previous year of more than $6,000,000. The greater part of the gain was due to the following advances in values: Cement from $4,969,437 to $7,485,715; petroleum from $32,398,187 to $37,689,542, and natural gas from $616,932 to $1,646,343.

This production by substances in 1910, precious metals omitted, was as follows, including quantities and values:

Asbestos	200	tons	$ 20,000
Asphalt	184,967	tons	2,325,122
Barytes	860	tons	5,640
Bituminous rock	87,547	tons	165,711
Borax	16,828	tons	1,177,960
Brick	340,883	M	2,934,731
Cement	5,453,193	barrels	7,485,715
Chrome	749	tons	9,707
Coal	11,033	tons	23,484
Copper	53,721,032	pounds	6,677,586
Feldspar	760	tons	5,720
Fuller's earth	340	tons	3,820
Gems	.....		237,475
Gypsum	45,294	tons	129,152
Glass sand	9,124	tons	8,165
Granite	486,098	cu. ft.	417,898
Infusorial earth	1,843	tons	17,617
Iron ore	579	tons	900
Lead	2,594,257	pounds	115,319
Lime	479,507	barrels	477,683
Limestone	684,635	tons	581,208
Mineral paint	200	tons	2,040
Marble	18,960	cu. ft.	50,200
Macadam	2,350,398	tons	1,104,526
Magnesite	16,570	tons	113,887
Manganese	265	tons	4,235

SAND AND STONE FOR CONCRETE.

The specifications for sand and stone to be used in concrete for large works in Belgium and Germany are frequently rigid as to the percentage of voids, according to a statement by Mr. William Challoner, in a paper before the Association of Municipal and County Engineers, at London. A common clause specifies the limit of foreign material in the sand as 2 per cent, sets the fineness or coarseness of the grains, and requires that it shall be graded so as not to contain more than 40 per cent of voids. If the foreign matter is in excess of the limit provided, the contractor understands that the sand will have to be washed, and if the limits of coarseness or fineness are exceeded it will require to be sifted, and further, that if the forms and sizes of the particles cause a greater proportion of voids than is allowed by the specifications, he will have to obtain other suitable grades to mix with the bulk in order to reduce the voids to their proper proportion.

From compliance with the first two conditions no amount of argument will secure to the contractor any concession, but in the last he may in some cases have the option of using a sand containing a slightly greater percentage of voids—providing he uses a relatively greater proportion of cement or other specified binding medium to fill them; with the result that he usually elects to grade the sand.

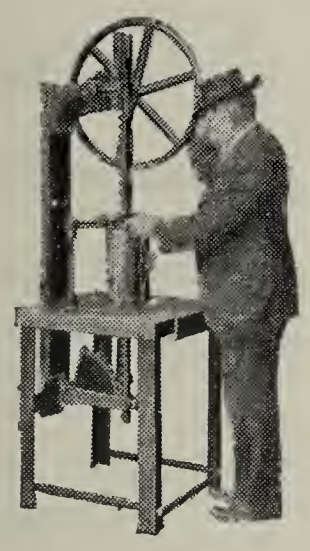
Similarly, if the contractor provided a suitable sand containing a less percentage of voids than 40 per cent he may in some cases be permitted to reduce the quantity of binding materials.

In like manner the specification of stone for making

concrete, after limiting the size of the smallest and largest particles, which may vary in respect to the particular necessities of the work, describes that it shall be hard and not capable of absorbing more than 6 per cent of moisture, nor shall it disintegrate at a temperature between 1 deg. C. and 200 deg. C. It shall be thoroughly washed free from dust, earth or other foreign matter and the period of this operation is limited to some suitable specified period before it is mixed in the concrete. To these restrictions are usually added others to secure the exclusion of stone or ballast which contains traces of sulphur or oxides of iron, or to prohibit the use of burnt chemical refuse, slag, or carbon materials which may contain these elements.

CEMENT TILE IMPROVEMENT.

Dealers who study to satisfy the increasing demand of farmers for up-to-date agricultural machinery, will be interested in a few facts regarding that most modern product, the Cardiff Cement Tile Machine. Saving the farmer's money is the Cardiff's specialty. All through the middle west dealers are finding this machine a very profitable mint through its ready purchase by farmers who use but a moderate quantity of tile annually but demand that that used be the best as well as the most reasonable in price.



Citing a single township as proof of this big retail demand, the Cardiff's manufacturers—the Leavitt Manufacturing Co., Box E, Urbana, Ill., show that in one such township—Middlefork—of Vermillion County, Illinois, there are ten Cardiff machines today in actual farm use. Wide-awake dealers in other territory have profited enormously by this increased demand, which will go on and on.

The Leavitt Manufacturing Co. is now preparing plans for an immense addition to its plant at Urbana which will practically double its machine shop space. The new addition will be of brick, with reinforced concrete floors, and steel and glass sides. It will be absolutely fireproof and designed after the latest factory models.

CONCRETE PRODUCTS.

The Clay County Tile and Brick Company has been organized at Pigott, Ark., and are successors to the Rector (Ark.) Tile and Brick Company. They will begin operations soon and will manufacture concrete tile, brick, blocks and burial vaults. W. S. Whetston is president and L. Whetston secretary. The company is in the market for concrete machinery.

CEMENT SILO CONSTRUCTION.

By M. S. King.

Stave Silos.

Faulty as the stave silo is in a great many respects, we cannot get away from the fact that this is today the most generally built of all kinds, and there must be some reason for it. There were simply thousands of these built in the middle west last summer.

They are easiest of all silos to erect, requiring a lower grade of workmanship, and less time than others. They have their faults; they will decay, need attention, and will blow down. However, thorough guying eliminates most of the latter trouble, and a great number of people do not look far enough ahead to see the value of the masonry silo. Furthermore, procrastination, the besetting sin of so many farmers, invariably results in a stave silo or none. That is, a stave silo can be bought and erected when it is too late for any other.

Masonry Silos.

Masonry silos are a thoroughly established success; but even here concrete has its old rival—clay products. Cement products and clay products and stone have each been large factors in establishing a very enviable reputation for masonry silos where these materials have been properly used, with the right amount of steel. Those interested in the sale of wood silos have been largely responsible for some very strong prejudice against the masonry silo.

A few mistakes have been made, but they are comparatively few and do not justify the publicity which they have received. Properly built masonry silos have never failed in any way. And it does not cost an excessive amount of money to build them properly.

First, it is claimed that masonry silos burst. Properly reinforced masonry silos do not burst and never did. It is claimed that large amounts of mould occur near the wall. This may happen in any silo that is not properly filled. However, if the masonry silo wall is smooth, vertical and impervious, mould is no more liable to occur against this kind of a wall than any other. It is claimed that more freezing occurs within the masonry silos than in the two-inch wooden walls. Dry wood is warm, but the wood next to the silage is never dry. No more freezing occurs with a three to six-inch concrete silo wall than within a two-inch wooden wall.

Finally it is claimed that the acid formed in the fermentation of the silage destroys any masonry material, steel or any other substance aside from wood. The peculiar thing is that this same acid is supposed to preserve wood. This acid is one of the weakest organic acids and occurs in very few percentages. It probably has no perceptive action on any materials either causing disintegration or preventing decay. However, moisture, heat and presence of air do cause the decay of wood.

Essentials.

Before going into the details of construction we should understand the requirements of a silo. Freshly cut green corn is simply packed tightly, as near uniformly as possible, in a large circular building, and in the absence of air there is a slight fermentation, heating the corn up to a sufficient temperature to cook it to a considerable extent. The silage is to corn what kraut is to cabbage. After filling, the excessive weight of this feed causes it to settle.

If the wall is not smooth there will be air-pockets between the silage and the wall. This same pressure will cause the silage to press out slightly, tending to fill in the small recesses in the wall; but the wall should be as smooth as possible. Also, the walls must be air-tight, because any air admitted to the silage will cause it to mould and decay. In order to make the doors tight they should

be mudded in. Of course, air comes in contact with the silage at the top, and enough corn rots to shut off the air from the silage below. Careful tramping after settling will reduce the loss, as less corn will be required for this air-tight cover.

Reinforcing.

The settling of the feed, its heating and consequent expansion, cause considerable outward pressure on the silo walls. In order to prevent the pressure from bursting the walls they should always be reinforced with steel.

There are a few cases of successful silos having been built practically without steel. This, however, is no sign that it is safe, as we simply have no factor of safety and nobody knows how near these silos come to bursting. There are many bursted masonry silos in the country, and a few silos without reinforcement have happened to stand. But it is absolutely unsafe to depend upon masonry alone to withstand this pressure. Steel must be used. This pressure amounts to about 11 pounds per square foot for every foot in depth. That is, at a depth of 40 feet the pressure would be approximately 440 pounds per square foot.

The cost of reinforcing does not exceed 5 to 8 per cent of the total cost of building and it is the only way to make the building safe. From one of the illustrations in Bulletin 100 of 117 of Iowa State Experiment Station you will see the quantity of steel necessary for different sizes of silos. This pertains entirely to horizontal reinforcement, all hoops and bands placed in the wall.

Recommendations for vertical reinforcing have emanated from several apparently reliable sources. Careful and extensive investigation in silo work in the last four years has failed to indicate to me that vertical reinforcement in the wall is necessary except at the door frames. Such reinforcement really does no harm, but does cost money and requires time to prepare and place, and so far as I have been able to learn, no failure has ever occurred on account of its absence.

It is, of course, reasonable to suppose that horizontal reinforcement could be far enough apart to make this necessary, but where ¼ to ½-inch steel is placed as often as is necessary there seems to be no reason for the vertical steel.

Block Versus Monolithic.

Looking at the silos from the standpoint of the trade, they divide themselves according to material; that is, cement products or clay products. However, in a great many ways it is more logical to divide as to methods of building; that is, poured or monolithic silos and block silos. The two are fundamentally different in that they require very different circumstances.

The cost of equipment for block work will vary from $50 to $150 for outfit which can be used on different sized silos. It consists of scaffold apparatus for obtain-

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Ceresit is just as efficient when incorporated in cement mortar used on structures built of concrete, brick, stone, tile, and on buildings whose surface is of stucco or cement plaster.

Ceresit is guaranteed to be a satisfactory waterproofing on any work done under our direction.

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(17)

ing proper shape; that is, round and plumb; jin poles; and a small hoisting engine—one or two-horse—is often advisable. Equipment for monolithic silos will cost from $100 to $500, depending upon how extensively one expects to follow the work. The same or a more expensive scaffold than for blocks will be required. The forms will vary in cost from $50 to several hundred; also, in addition to the hoisting engine a concrete mixer is quite essential. The cost of forms for blocks are considered in cost of manufacture.

Foundations.

For walls 6 inches in thickness and 40 feet in height the weight upon each foot of circumference will probably not be far from 3,000 pounds.

It is common on good soils to allow 3½ tons per square foot on soil bearing surface. It is convenient to make the foundation from 18 to 24 inches wide, which reduces the pressure to one ton per square foot or less, which makes it very safe. This can be conveniently arranged by simply digging a wide trench around the outside of the pit. The pit should only be deep enough to get the foundation below the frost line. In building the foundation the excavation can be done neatly and only inside forms are necessary, or blocks may be used. There seems to be no reason why the wall below the ground should be thicker than that above.

Doors.

There are two general forms of doors which may be used; the so-called continuous and individual doors. The latter are merely openings in the wall 22 to 24 inches in width and 30 to 36 inches in height, spaced a few feet apart vertically.

In the continuous door it is quite different and considerably more convenient. It is the same in width, but it is considerably higher, having an opening from 4 to 6 feet in the clear, and these openings separated only by reinforcing bars encased in 6 or 8 inches of masonry. These openings are closed by short doors so that in no case is it necessary to pitch the silage high in removing it.

Roof.

The only logical type of roof is a concrete roof for a concrete silo, and my experience is that the best and easiest form of roof to build is a conical roof of ¼ to 1/3 pitch. The roof appears more difficult to the average man than it really is. In reality it is a very simple job.

Rafters are simply cut out to the required pitch, enough of them used so that they will not be more than 6 feet apart at the base, curved headers of one-inch lumber will be placed between the rafters not over 2½ feet apart, and over this is placed barn boards ripped corner ways.

The sheeting should then be covered with woven wire. For a 16-inch silo it is necessary to place the equivalent of ½-inch square bar in the concrete directly over the wall. This prevents the roof from spreading, due to the weight of the concrete. Any scrapes of reinforcing remaining from the work may be cut in lengths from 3 to 6 feet and laid on the woven wire reaching out to the circular steel above the walls.

WILLIAMS PATENT CRUSHER AND PULVERIZER CO.

The latest catalog of the Williams Patent Crusher & Pulverizer Co. of Chicago and St. Louis, describing raw material grinders, is an elaborate publication containing a great number of cuts of the various parts of the disintegrators, grinders and pulverizers manufactured by this company.

The Williams pulverizers are well known in the cement industry and have stood the test of fifteen years in American cement plants. Why they have given such excellent service is fully explained in this new catalog which will be mailed to manufacturers free of charge.

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QUICK DELIVERY.

The well known manufacturers of fire brick for cement and lime kilns, the Ashland Fire Brick Company, Ashland, Ky., received the following letter from one of their customers the other day, viz.: "On Saturday, last, we telephoned you a rush order for 20,000 brick and a car of ground fire clay, and we wish to announce that these three cars were received at our Mayville furnaces yesterdaly, the 8th inst. The distance from Ashland, Ky., to Mayville, Wis., is 575 miles. We understand that these cars were ready to move from your factory on Monday morning, last, and they arrived at our operation over this long mileage in just about six days after material was ordered from you. We wish to express our appreciation of the prompt manner in which this commission was handled by your company. Yours truly, The Northwestern Iron Company."

MUSHROOM SYSTEM OF REINFORCED CONCRETE CONSTRUCTION.

Notable examples of the Mushroom System of Reinforced Concrete Construction as adapted to office, business and commercial buildings, hotels, ice and cold storage plants, warehouses, bridges, etc., are excellently illustrated in Bulletin No. 12, published by C. A. P. Turner, M. Am. Soc. C. E., the originator, patentee and manufacturer of the Mushroom System, 816 Phoenix Building, Minneapolis, Minn. In the text is given many cogent reasons why an owner should prefer reinforced concrete and why in deciding on the method of construction the Mushroom System should be adopted. The illustrations presented give evidence of the many advantages possessed by this System. Any one interested, can secure copy of this valuable book by mentioning Cement & Engineering News.

REINFORCED COTTON GIN.

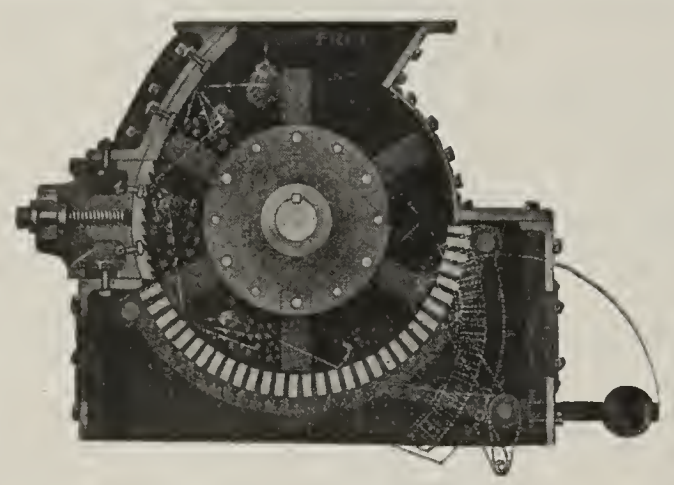
The Choctaw (Okla.) Cotton Oil Company have recently completed at Shawnee, Okla., a reinforced concrete gin which is probably the largest gin in the southwest. The work is of such excellent character that the Oklahoma Portland Cement Company of Ada, Okla., have prepared blue prints and photographs for a four-stand gin, which can be constructed at an estimated cost of $2,010.

The cement company will furnish a copy of the blue print free to any one who is interested in building a similar plant. Statistics show that about 200 cotton gins burn each year, and this invariably happens during the busy season.

The Choctaw Cotton Oil Company now have a fireproof gin and contemplate replacing some of their wooden buildings with concrete as fast as they can consistently make the change.

LIMESTONE FOR CONCRETE.

Broken limestone for concrete aggregate is not permitted in the construction of the sewerage system at Louisville, Ky. The joint report of Mr. J. B. F. Breed, chief engineer, and Mr. Harrison P. Eddy, consulting engineer for the commissioners of sewerage, states that the reason for excluding in the specifications the use of the local limestone, which is very common and comparatively inexpensive, is that it cannot withstand erosive action as well as gravel dredged from the Ohio river. Comparative tests of concrete containing river gravel and broken limestone were made very early in the studies for the sewer system, and it was found that concrete composed in part of river gravel would wear as well and in many cases better than ordinary sewer brick; concrete made with broken limestone did not withstand abrasive tests nearly as well as did the gravel concrete.



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Reduces Limestone for Cement Plants
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Raw Limestone 10 to 200 tons per hour.
½ inch and under.

For Tube Mill Feed

90% pass 20 mesh; capacity, 5 to 50 tons per hour.

For Concrete Work

Reduces the stone to a blended product for CONTRACTOR. Capacities from 1 to 25 tons per hour.

Write for Catalog No. 31-C, illustrating and describing the superior features of Jeffrey Crushers and Pulverizers.

JEFFREY MFG. CO. Columbus, O.

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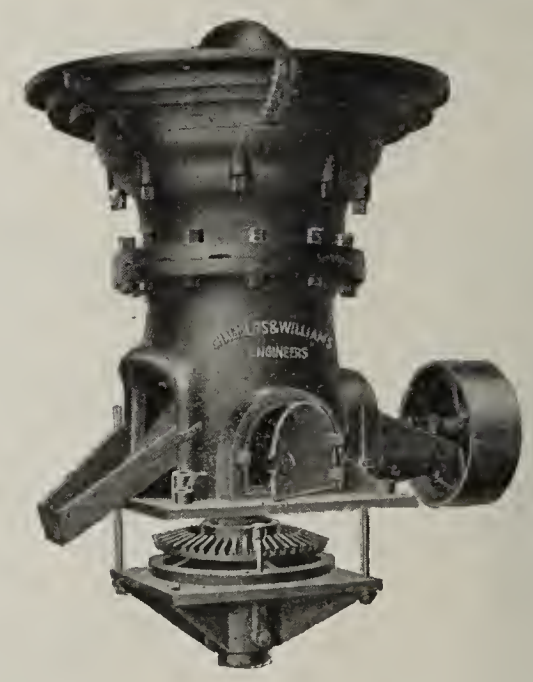

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BRONZE BALL GYRATORY CRUSHER

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"QUARTZITE" FOR CONCRETE FACING.

The interest in special sands and crushed materials for facing concrete work of various kinds is increasing rapidly. Concrete men are coming to see that they can get a better price for their work and increase their profits by giving their concrete an artistic finish.

"Quartzite" is a cream-white silica sand crushed from quartz rock by the Cheshire White Quartz Sand Co., Cheshire, Mass. Its grains are well graded in size, sharp and angular, each one being covered with hundreds of hard, strong points that form a perfect bond in the concrete. This material is used extensively in the east in connection with white Portland cement and is also used in concrete work that is done in color. Its use adds little to the total cost of the work.

ORE DOCK CONSTRUCTED OF CONCRETE.

The Lake Superior & Ishpeming Railway is building an ore dock at Marquette, Mich., in which the underpinning is of concrete, lightly reinforced with structural steel, while the bins and other upper works are of steel. The dock is 75 feet high and 60 feet wide and will provide storage capacity for 60,000 tons of iron ore. The length of the dock proper is 1,200 feet, while the total length of the steel structure, including the approaches and the incline trestle, is approximately 700 feet more. There are four railroad tracks on the top of the dock. The machinery and the chutes, of which there are 200 sets, are operated by electricity. The cost was between that of the old timber design and one where steel is used throughout.

BOOK REVIEWS.

There is perhaps no name more familiar to manufacturers of Portland cement than that of Richard K. Meade, the chemist, who has had such a large part in the development of the Portland cement industry in the United States. Mr. Meade is now general manager of the Tidewater Portland Cement Company.

His book, entitled "Portland Cement," which takes up its composition, raw materials, manufacture, tests and analysis, is one of the standard volumes in the industry and will be for some time to come, since it has just been revised down to date and the second edition has been issued by the publishers, the Chemical Publishing Company.

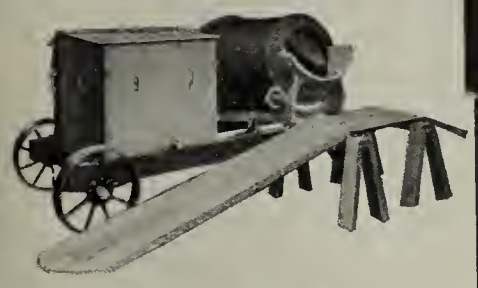
In this second edition the entire text of the book has been revised and much new matter has been added, particularly to the section on manufacture, which has been increased about 70 pages. This has been made necessary in order to include descriptions of all the newer appliances for the manufacture of Portland cement, making this department fully representative of the present state of the industry. The other sections of the book have also been revised correspondingly, bringing them up to date.

The book as revised comprises over 500 pages with a large number of illustrations and complete index. The price is $4.50, and will be sent by Cement & Engineering News, 1117 Schiller Bldg., Chicago, Ill., on receipt of price.

PORTLAND CEMENT MATERIALS.

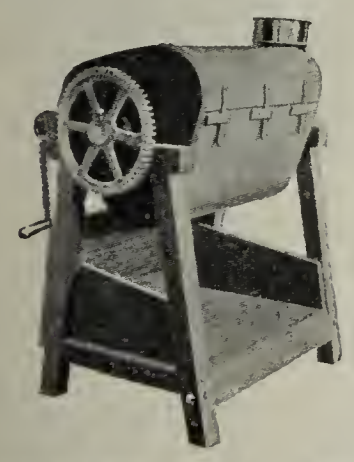
Three hundred acres of limestone and shale, situated in Southern California on railroad, close to market. Highest prices paid for finished product. An excellent proposition. Correspondence solicited. for sale or promotion. Box 43, Halleck, Cal.

Northwestern Concrete Machinery



CONE BATCH MIXING MACHINE

Low loading intake cuts labor costs—open drum—self-cleaning features—variable discharge—all sizes. Strongest and simplest construction known. Steam, gasoline or electric motor power.



WOOD FRAME HAND BATCH MIXER

Low-priced machine for use of the man who needs a mixer for occasional jobs. A minute batch mixer, handling wet or dry mix. Strongly constructed—gives excellent service.

The *Northwestern* line is the largest and most complete line in existence. It includes everything from the smallest mould to the largest and most complete outfits. Everyone should have our special catalogs showing these machines, tools and forms.

Northwestern machines embody the best and most simplified construction, are speedy and durable—guaranteed absolutely, with returnable privilege if not entirely satisfactory. This large factory enables you to secure the most modern machinery at wholesale prices.

It means money saving to get in touch with the *Northwestern* line. Send for catalogs today advising what machines or moulds you are interested in and they will be mailed to you promptly with full and complete information.

WHOLESALE PRICES

Block Machines, $10 to $250; Brick Machines, $22 to $75; Mixers, $24 to $1,000; Porch Column and Baluster Outfits, $15 to $75; Cap and Sill Moulds, $12 to $35; Lawn Vases, $15 to $25; Ball Moulds, $2 to $17; Grave Stone Moulds, $7 to $69; Well Curbing Moulds, $4 to $7; Drain and Sewer Tile Moulds, $6 to $83; Block Cars, $11 to $17; Fence Post Moulds, $7 to $12; Silo Moulds, $14 to $150; Coping Moulds, $18; Hitching Post Moulds, $20; Baluster Moulds, $6 to $18; Jardinieres, $12; Special Gate Post Moulds, $10 to $30; Newel Post Moulds, $14; Grave Markers, $7; Burial Vaults. $90.

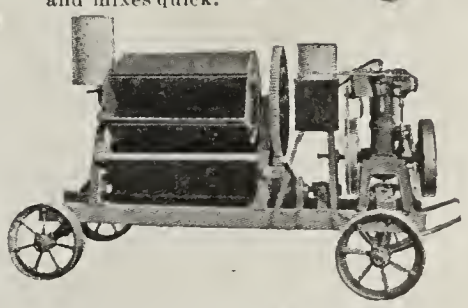
Special Contractors' equipment, including culvert forms, drain and tile moulds, rock crushers, cinder crushers, elevators, sand screens, all tools needed for concrete work, block machines of every description, special forms, wheelbarrows, gasoline engines, ornamental moulds of all kinds, waterproofing, etc.

Write for particulars. Tell us what you are interested in so we can send full information and the proper catalog.

Northwestern Steel & Iron Works, 1053 Spring St., Eau Claire, Wis.

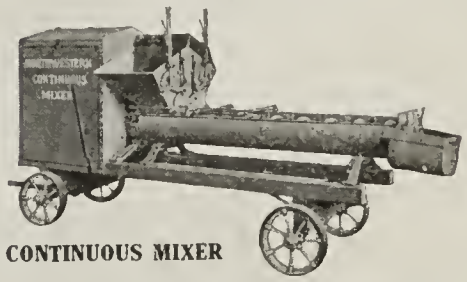
TRIANGULAR CONVERTIBLE HAND BATCH MIXER

For either hand or power mixing. Equipped with either one or two cranks or supplied with power attachment for engine. Fine for block plants, tile work, etc. Uses wet or dry mix, has good capacity and mixes quick.



TRIANGULAR SIDEWALK MIXER

A compact, portable machine for sidewalks and foundations. A very low price, speedy machine easily moved—can be fastened to wagon and moved from job to job. Exceptional mixing qualities, well made and very desirable for medium work.



CONTINUOUS MIXER

Splendid machine for block plants, tile works, sidewalks and general work. Adapted also for mortar mixing. Very compact and portable. Double screw action. Variable speed enables regulation for big or small crew. The only variable speed continuous mixer on the market

The Novo Engine Has No Lateral Vibration

—no packed water joints to leak—no heavy cooling system—no timing troubles—no freezing damage in cold weather.

There isn't another engine which meets the requirements of concrete work better than the

NO TANK
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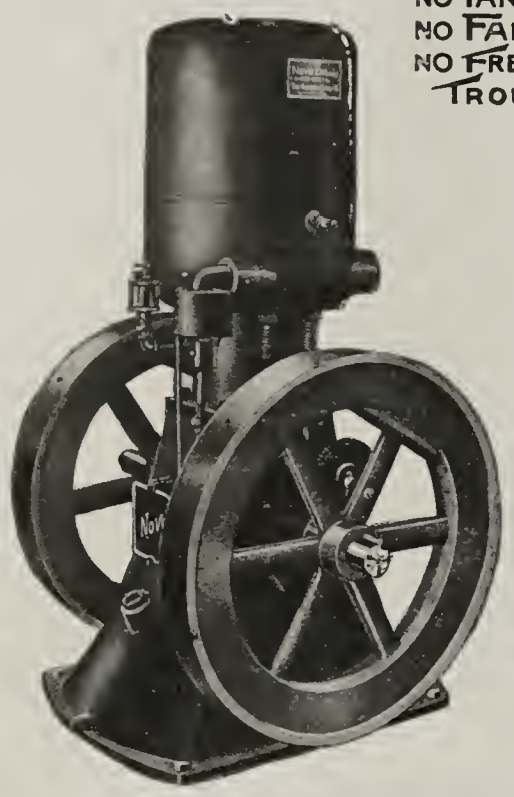

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It is simple in construction, easy to start and run in all weathers, and readily portable—the lightest engine for power developed. Made in from 1 to 10 H. P. and are guaranteed to deliver it. The cooling system is self-contained and is proof against damage from freezing. Splash system lubricates perfectly main bearings and working parts which are enclosed so dirt cannot get at them.

The Novo is an ideal engine for concrete work and you owe it to your business to look into it thoroughly.

Send for Novo Catalog

and get all the facts.

Send for the catalog now while you think of it.

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Clarence E. Bement, Sec'y and Gen'l Mgr.

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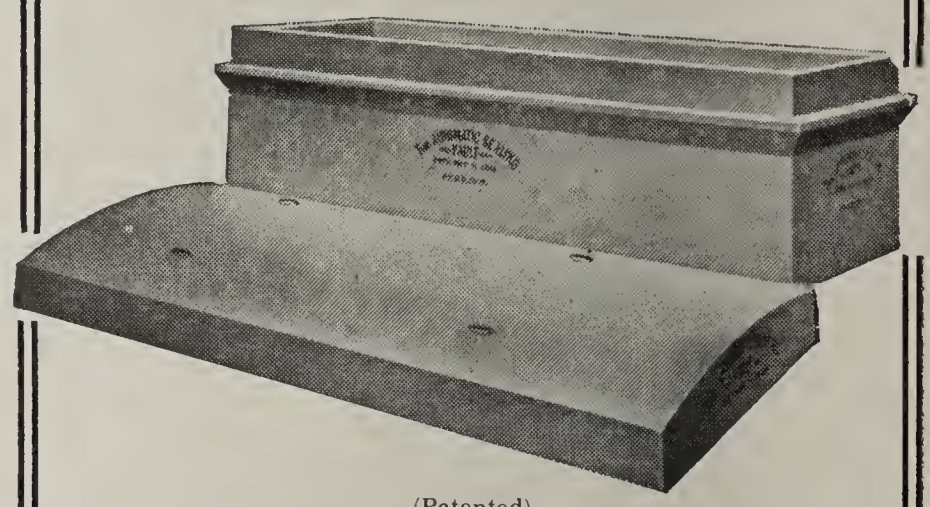
Write us for facts and figures.

Highest Pinnacle of Perfection

This is what our Automatic Sealing Vault and Adjustable Steel Molds stand for today. The Automatic Sealing Vault has from the first met with universal favor, and the already big demand for it is rapidly increasing. Sells on its own merits and always overcomes competition. Easy to make and easy and handle, and provides big profits for the manufacturer.

More Beautiful Than Stone or Steel



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READ THIS LETTER:

Lisle, N. Y., Feb. 24, 1912.

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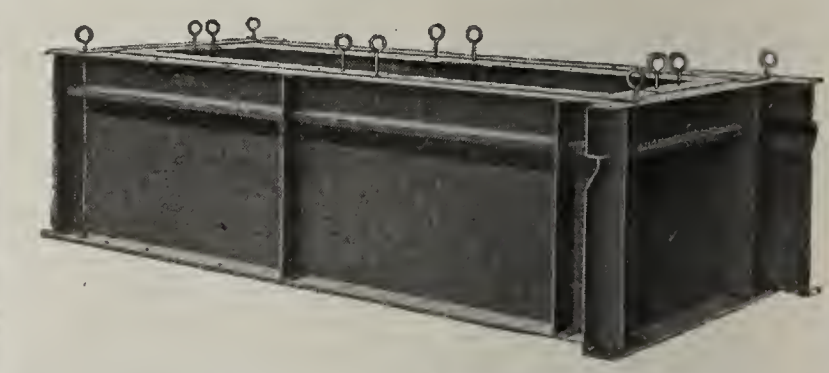
Dear Sirs:—Yours of the 7th received, and in reply will say I am having excellent success with your molds. They are all you claim of them and I am well pleased with the sales I am having. The undertakers are willing to discard all other cement vaults for the sales of the Automatic Sealing Vault.

I could never feel satisfied with a vault when you have to depend on paint or cement for a seal, as I feel sure that in time water will find its way through, but when you place a cover on the Automatic Sealing Vault you know that you have a seal that will last forever.

Yours truly,

EDWARD J. LUSK.



ADJUSTABLE BESSEMER STEEL MOLDS

Our Big Illustrated Catalogue fully describes this vault and molds and other devices which will interest you. Write today.

THE AUTOMATIC SEALING VAULT CO.

Peru, Indiana

NOTE—Try an order of our A. S. V. Waterproofing Solution, especially prepared for all kinds of cement products requiring a perfect waterproofing. Put up in 5-gallon cans at $1.00 per gallon.

CEMENT

... AND ...

ENGINEERING NEWS

CONCRETE AT THE CHICAGO STOCK YARDS.

Wooden structures are giving way to more durable and sanitary ones. Gradually, fence by fence and trough by trough, is rising a concrete stock yards from one of wooden pens and railings, etc. (See page 136.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

WILLIAM SEAFERT, Editor and Publisher

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When your subscription expires, renew at once, using the blank which will be sent you. If it expires with this issue, your renewal must reach us before the 5th of the next month, to avoid missing the next number.

Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

Advertising Rates Sent on Application

JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, MAY, 1912

BLANC WHITE PORTLAND CEMENT.

Mr. Maxwell Carrere, manager of the Blanc Stainless Cement Company, Allentown, Pa., writes: "It is with the deepest regret that I have to announce to you that the business of the Blanc Stainless Cement Company will be wound up.

"I devoted years to the perfection of this cement, as you know, but notwithstanding the fact that I covered every step of my investigations with patents owned by the company, our laws are such that without an enormous expenditure of money against powerful corporations it would be impossible for me to establish my rights, and as our business has reached a point now where it would be necessary for us to move the plant or erect a new one where the raw materials are situated, and vigorously defend our patents, we came to the conclusion that we had better wind up the business, as the loss will all be ours. We owe nothing outside that I know of.

"Whatever good we have done in raising the standard of construction and bringing to light a new product of merit, I know has been appreciated, and I can only add that I have done my utmost to make it a success and highly appreciate the assistance and the confidence you granted me.

"Personally I have no future plans and will remain here a while."

CEMENT PAVEMENTS.

A new sixteen-page illustrated publication is being issued by the Universal Portland Cement Co., "Permanent Pavement." It covers the field of good roads and while the company is now especially interested in pavements using concrete it will cover all types. It is to arouse interest in road improvement and in bettering farming conditions through better transportation facilities.

HAND AND MACHINE MIXED CONCRETE.

In your April issue you have an article on "Practical Concrete Construction," by DeWitt V. Moore, writes the Waterloo Cement Machinery Corporation, 22 Wood street, Waterloo, Iowa.

Under the heading "When Hand Mixing Is Justified," Mr. Moore states, "For instance, on a job of a couple of hundred yards, $100 would probably be expended in installing and rigging the mixer, or at the rate of 50 cents per yard, and it is doubtful if hand mixing would cost any more than this difference."

We manufacture a power mixer which weighs about 1,200 pounds and with which the contractor could make a profit of approximately $100 over hand mixing on a job requiring 200 yards of concrete.

We enclose herewith a comparison of the cost of hand mixing as compared with mixing with this little machine, and would be pleased to have you submit it to Mr. Moore. Our figures are taken from the best figures available to us and it may be that Mr. Moore has made a more extended and more exhausted investigation of the subject than we have. If we are wrong in our figures, we would like to be set right, and in any event, we would be pleased to have Mr. Moore's criticism on our statement.

Comparison of Hand and Machine Mixing Done by Our Machine, Little Wonder.

While cement workers' wages, including finishers, vary from 15 to 75 cents per hour in different sections of the country, statistics from a large number of places indicate an average wage of about 30 cents per hour, or $3.00 a day for a ten-hour day.

By hand work, 8 men will mix and place, on the average job, under the most favorable conditions, 20 cubic yards of concrete per day.

Eight men at $3.00 per day is $24.00 or $1.20 per cubic yard.

Now with our mixer (the Little Wonder), 6 men will mix and place 25 cubic yards of concrete per day. With more men the output can be proportionately increased.

6 men and the Little Wonder, at $3 per day	$18.00
Gasoline and lubricating oil, for 10 hours	.25
	$18.25

Or 73 cents per cubic yard.

Saving with the Little Wonder, the difference between $1.20 and 73 cents, or 47 cents per cubic yard, which, on 25 cubic yards means a profit of $11.75 per day over hand work, and in addition to this, you get perfectly mixed concrete. This will pay for the Little Wonder in less than 20 days, and thereafter yield an extra profit of 47 cents on every cubic yard of concrete mixed.

The Little Wonder will handle thirty to thirty-five cubic yards per day when the men become familiar with the work—one man writes that he averages thirty to thirty-five cubic yards in an eight-hour day.

UNIVERSITY OF WISCONSIN.

Announcement is made of the twelfth annual six weeks' summer school of the College of Engineering of the University of Wisconsin, which opens on the twenty-fourth of June.

Courses of instruction and laboratory practice are offered in electrical, hydraulic, steam and gas engineering, mechanical drawing, applied mechanics, testing of materials, machine design, shopwork and surveying, in addition to which subjects may be taken in the College of Letters and Science.

For bulletin address F. E. Turneure, University of Wisconsin, Madison, Wisconsin.

The Electrical Precipitation of Suspended Particles

By F. G. Cottrell*

(Continued from page 104.)

In order to insure that essentially all the free sulphuric acid and arsenic of these roaster gases should be condensed from true gases into suspended particles, which latter are all the apparatus purports to collect, and also to protect the lead construction from softening from the heat, it was found necessary to cool the gases down to less than 150° C. To accomplish this a system of water sprays was first used in the mouth of the lead flue just before the electrodes. This served the purpose very well as long as clean water which would not stop the sprays was available, and successful test runs of a week or more duration were made with this system, but as the circulating and

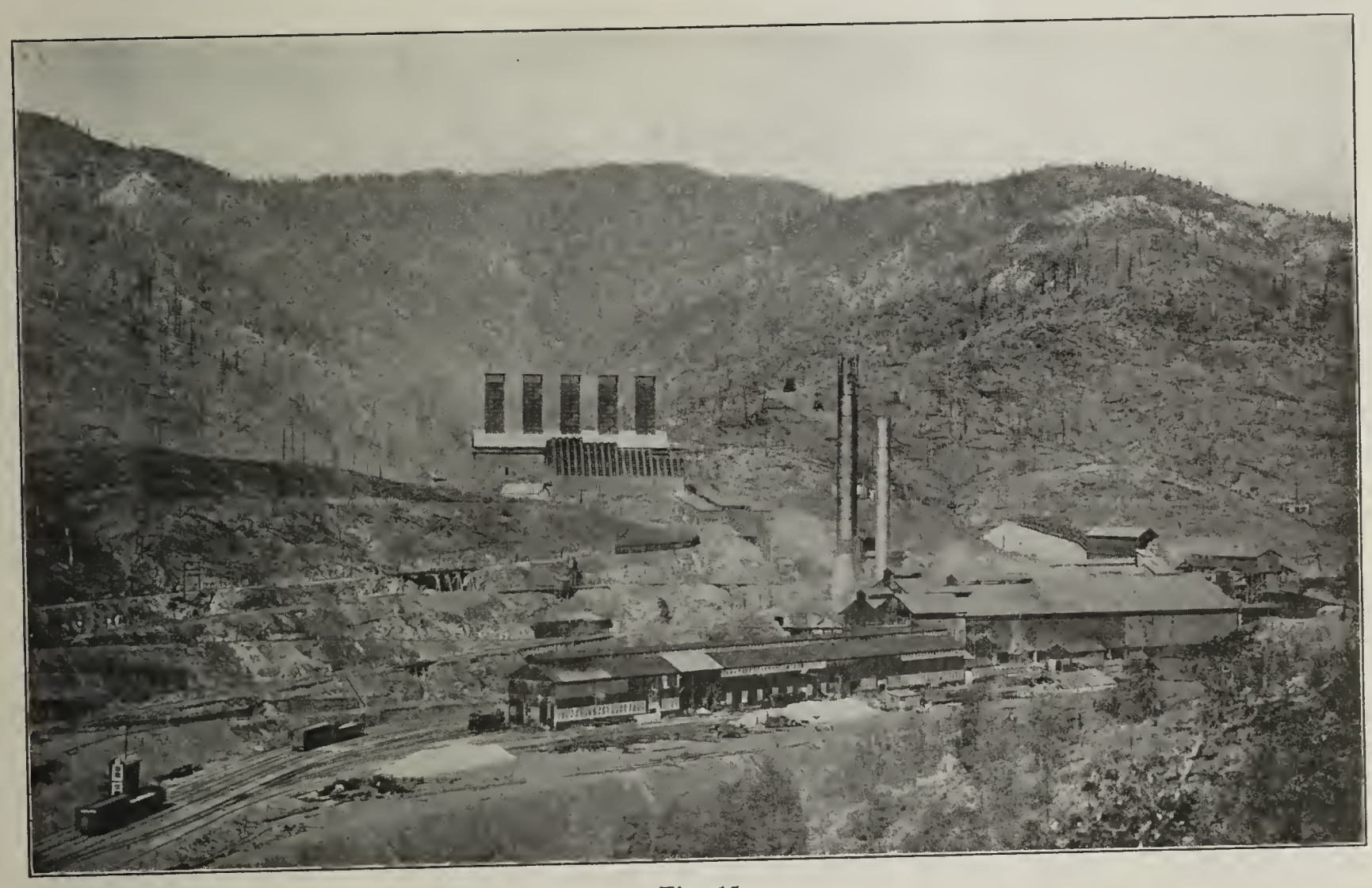


Fig. 15.

cooling water of the entire plant is derived from the Sacramento River, which is often very muddy, the difficulties of keeping the sprays clean and open determined the management of the plant to resort to cooling by radiation through a lengthening of the flue before the precipitator. This construction and the refitting of the apparatus for continuous operation has not as yet been undertaken, and as the litigation with the farmers seems for the present at least to have centered more about the question of sulphur dioxide, it is likely that the completion of the work will be allowed to await the reaching of an understanding on this matter.

The next installation in order of size to be undertaken was at the Balaklala Smelter at Coram, Shasta County, California. The vast body of low-grade copper ore reaching for many miles across this county and commonly known as the Copper Crescent has recently been described in detail by L. C. Grafton and characterized as the second largest copper deposit which can be considered as a single geological unit in the United States.

The first commercially successful smelter in this region was erected at Keswick in 1896 by the Mountain Copper Co., Ltd., under the management of Louis T. Wright and was of especial interest as one of the pioneers in pyritic smelting. Extensive heap roasting was also carried on at this plant with the result of wide-spread deforestation of the surrounding country and the final closing down of the plant in 1905 through injunction proceedings instituted by the U. S. Forestry Service. The company has since built a small smelter and acid phosphate works at Martinez on San Francisco Bay and now ships its ore to this point nearly 250 miles distant for treatment, but even this latter plant has at various times come in for its share of fume litigation.

In 1901 the Bully Hill Smelter at Delamar with a capacity of 250 tons a day was started. This was later purchased and is now owned by the General Electric Company, but since last July it has been closed as a result of complaints by the U. S. Forestry Service who insisted, at that time, that the plant either close or at least commence efforts on a practical scale looking toward controlling its fumes.

In 1905 the Mammoth Copper Mining Company, a subsidiary of the U. S. Smelting, Refining and Mining Company, blew in its present smelter at Kennett. This plant when running full has a capacity of some 1200 tons of ore per day.

The Balaklala, or First National Copper Company, is the most recent of the Shasta County smelters, having blown in its first furnace in 1908.

These smelters are all situated in the narrow precipi-

*Inventor of process used at the Riverside Portland Cement plant in California for the prevention of dust.

tous canon of the upper Sacramento River and its tributary, the Pitt. The region itself is too steep and rocky for agriculture but was once heavily wooded, although now swept bare of vegetation for miles. As far as the canon itself is concerned probably all the damage possible has already been done unless reforestation were undertaken. This latter even would probably be slow and difficult work as since the loss of vegetation the steep hillsides have been washed bare of soil for miles around. At Redding, however, some 13 miles below Coram and 17 miles below Kennett, the canon widens out into the fertile Sacramento valley and from this point southward for some 12 miles further lies the region from which for the

Fig. 16.

past two years have come increasingly insistent complaints against the smelters. These culminated a little over a year ago in agreements between the farmers and the smelters under which friendly suits were brought in the federal courts and injunctions issued by stipulation requiring the smelters to remove the suspended matter from their exit gases and dilute the latter to such an extent that their sulphur dioxide content should not exceed seventy-five hundredths of one per cent by volume as discharged from the stacks, with the further general and sweeping provision that they should do no damage.

To accomplish this the Mammoth Smelter installed a bag house which has been in very successful operation since last July. Fig. 15 is a view of this plant showing the bag house on the left in operation. It will be noted that the gases discharged from the five stacks (each 21 feet square) are to all intents and purposes free from suspended matter and consequently invisible. This represents a notable achievement, being the first time that the bag house, so efficient in lead smelters, has been successfully applied to copper blast furnace gases on the large scale.

It is made possible in this instance through neutralization of the sulphuric acid in the gases by the zinc oxide carried over in the fume from the very heavy zinc content of the ore smelted. The Company is also the owner of patents on the introduction of finely divided metallic oxides into the gases for this purpose. In addition it was necessary to provide an extensive system of cooling pipes seen in front of the bag house in the picture. There are 39 of these pipes each 4 feet in diameter and averaging about 200 feet in length. They represent a very large part of the cost of the installation. It was expected that they would be sufficient to cool the entire gases of the plant to a safe temperature to protect the $30,000 worth of woolen bags with which the house is filled, but upon starting up it was found that only a little over half the full capacity of the plant could thus be treated with safety and operations were accordingly restricted to this. In the cold weather of winter a considerably larger tonnage can be handled with safety than during the hot summer. Notwithstanding this, however, the bag house is to be considered a decided success at least for the particular conditions met with at this plant and the management deserves great credit for the courage and skill with which

it has carried through this new, and after all largely experimental, undertaking, representing as it does the expenditure of over a quarter of a million dollars.

In the case of the Balaklala Smelter, of which Fig. 16 is a general view, the use of a bag house was also considered and in fact a small experimental unit containing a few bags was run for some months in comparison with tests both by the electrical process here described and also a centrifugal apparatus in which the gases passed through a rapidly rotating cylindrical shell equipped with radial baffles to insure the gas being raised to full velocity. As

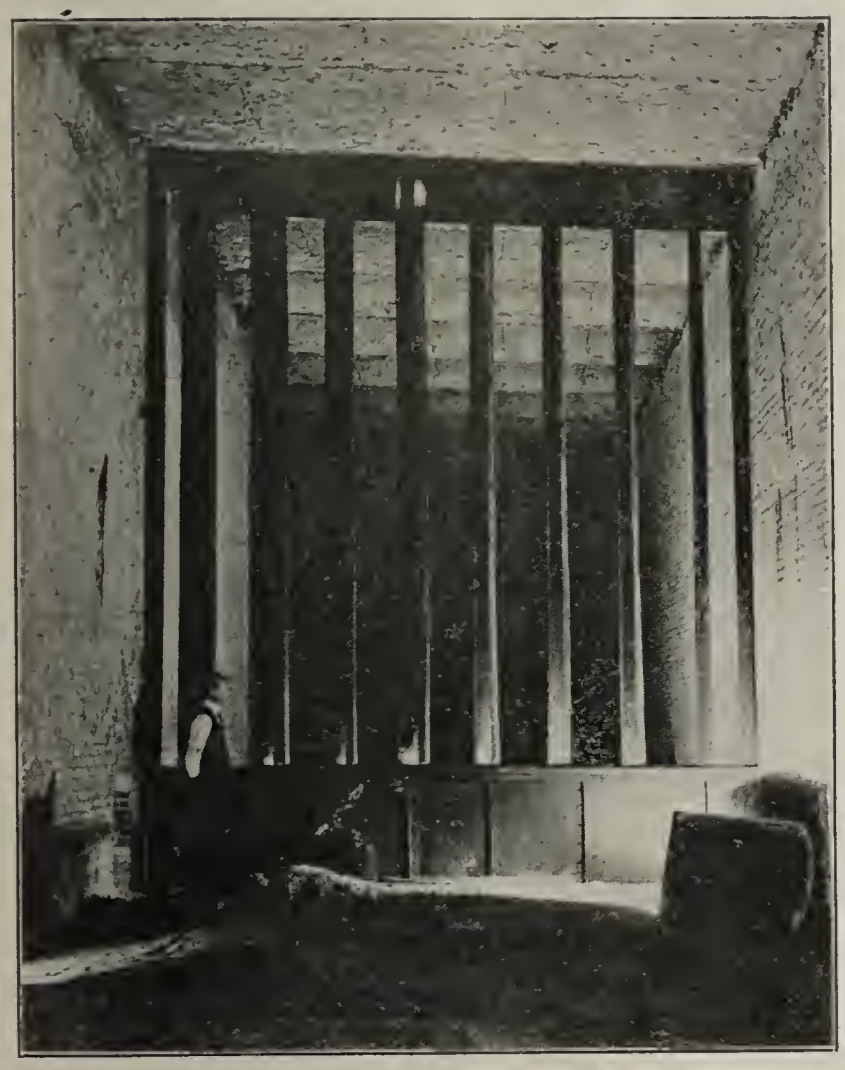


Fig. 17.

a result of these tests the electrical process was adopted for the full-sized installation.

The smelter treats from 700 to 1000 tons of 2½ to 3 per cent ore carrying over 30 per cent of sulphur with considerable but varying amounts of zinc. The greater proportion of this is handled in blast furnaces but the fines including everything under an inch and amounting to less than 10 per cent of the whole go through MacDougal roasters and an oil-fired reverberatory. The plant has also two converter stands. The gases from all these departments pass into a common flue 18x20 feet in cross section, an interior view of which at the main by-pass damper is shown in Fig. 17. The volume of gases passing through this flue varies with operating conditions from a quarter to half a million cubic feet a minute which means in round numbers a mean linear velocity in the flue shown of 10 to 20 feet per second.

Before attempting to design the full-sized equipment for treating these gases a small precipitation chamber capable of treating about 1 per cent of the total gases was erected and an extended set of experiments made with it. Fig. 18 shows this small unit with its exhaust fan and stack. In the original tests it was located nearer the base of the main stack, the figure showing it in its present state as modified for other experiments and tests.

Figs. 19 and 20 indicate the degree of success attained with this small unit in its original position having been taken a few minutes apart with the electric current respectively off and on, the same gas volume issuing in both instances from the stack which is 2 ft. in diameter.

With this miniature unit as a guide the equipment of the whole plant with similar appartus was undertaken in March of last year. This was completed and first put into operation the end of the following September, since

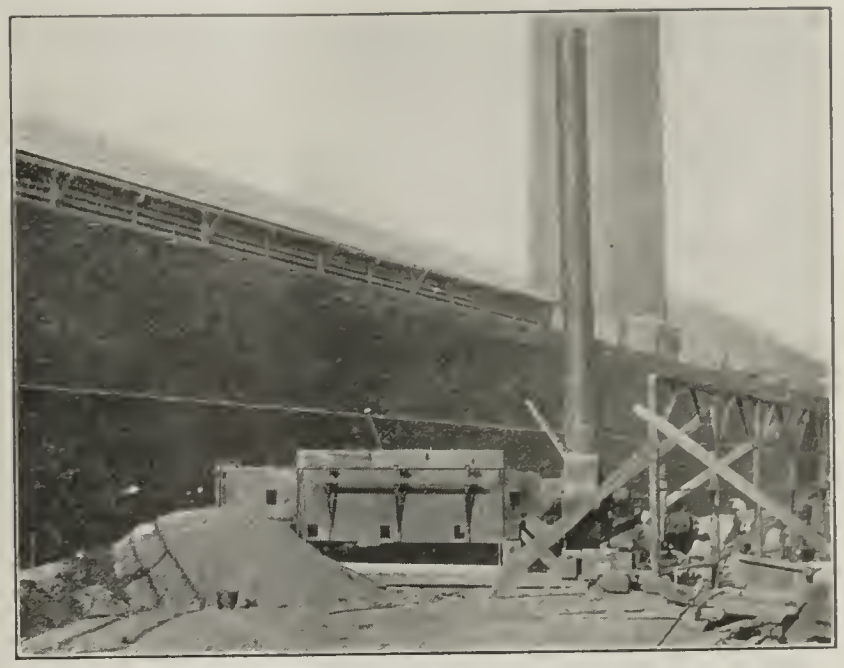


Fig. 18.

which time it has been in continuous operation, with the exception of the latter half of December when changes were decided upon during whose carrying out it became necessary under the terms of the court decree to shut down the plant for a couple of weeks.

As was naturally to be expected many difficulties were encountered, some of which have already been entirely

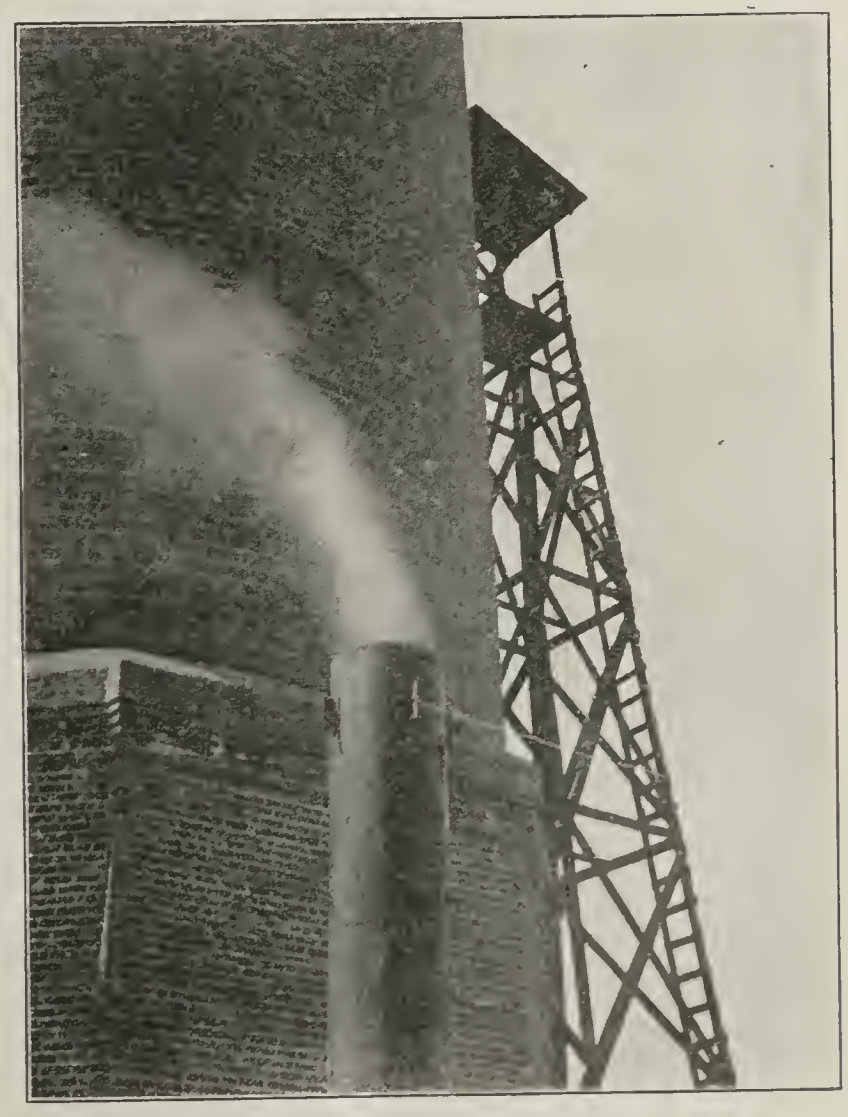


Fig. 19.

overcome while others are giving way more gradually before the systematic study of operating conditions.

Fig. 21 is a plan of the nine electrical precipitation units or chambers in their relation to the flue system and stack. It should here be noted that the two large fans indicated in the drawing are not required for the operation

of the precipitating system nor to overcome any added resistance due to its introduction as this latter is very slight indeed. The fans were made necessary by that section of the court's decree requiring dilution of the sulphur di-

Fig. 20.

oxide to three-quarters of a per cent or less. When the furnaces are running on a high sulphur charge this feature of the decree necessitates a considerable dilution of the gases with fresh air and corresponding diminution of stack draft. At these times the fans are operated, but during a considerable portion of the time the sulphur dioxide in the gases can be brought low enough without interference with the draft, and during these periods the fans are stopped entirely although the gases still pass through them.

At the rectifier building the current is received from the companies' three-phase power circuit at 2300 volts, 60 cycles, and after being transformed up to from 25,000 to 30,000 volts under the control of the operator through variable resistance and induction regulators is rectified into an intermittent direct current as already explained and distributed to the individual precipitating units.

Fig. 22 shows a cross section through one of these units or precipitating flues as first installed. The double vertical lines represent the collecting or grounded electrodes each 6 inches wide by 10 feet high made of No. 10 sheet iron. The dotted lines represent the discharge electrodes consisting of two iron wire strands between which is twisted the discharge material, for which both asbestos and mica preparations have been used in this plant. Each unit contains 24 rows of 24 electrodes of each type. The collecting electrodes are carried by bars connected directly to the frame of the chambers themselves while the discharge electrodes are spanned by springs between a system of buss bars carried on externally placed insulators as shown in the figure. To the auxiliary chambers surrounding these insulators a small regulated amount of air is admitted to prevent conductive dust or fume from working back and settling on the insulators.

The cam and shaker rod extending across the middle of the unit was originally designed for the purpose of vigorously shaking the electrodes as it was greatly feared that the removal of precipitate from the electrodes in units of this size might be one of our most serious problems. In actual operation it has been found, however that the electrodes can easily be shaken by hand from the top entirely free from dust, the whole operation including cutting the unit in and out of the system and the removal and replacement of its covers requiring only about ten minutes, and this having to be repeated every six or eight hours, depending on the dust content of the gases. The precipitated dust and fume as it falls from the electrodes is carried by the conveyor in each unit to a common longitudinal conveyor which in turn discharges into cars carrying it away for treatment and recovery of its values.

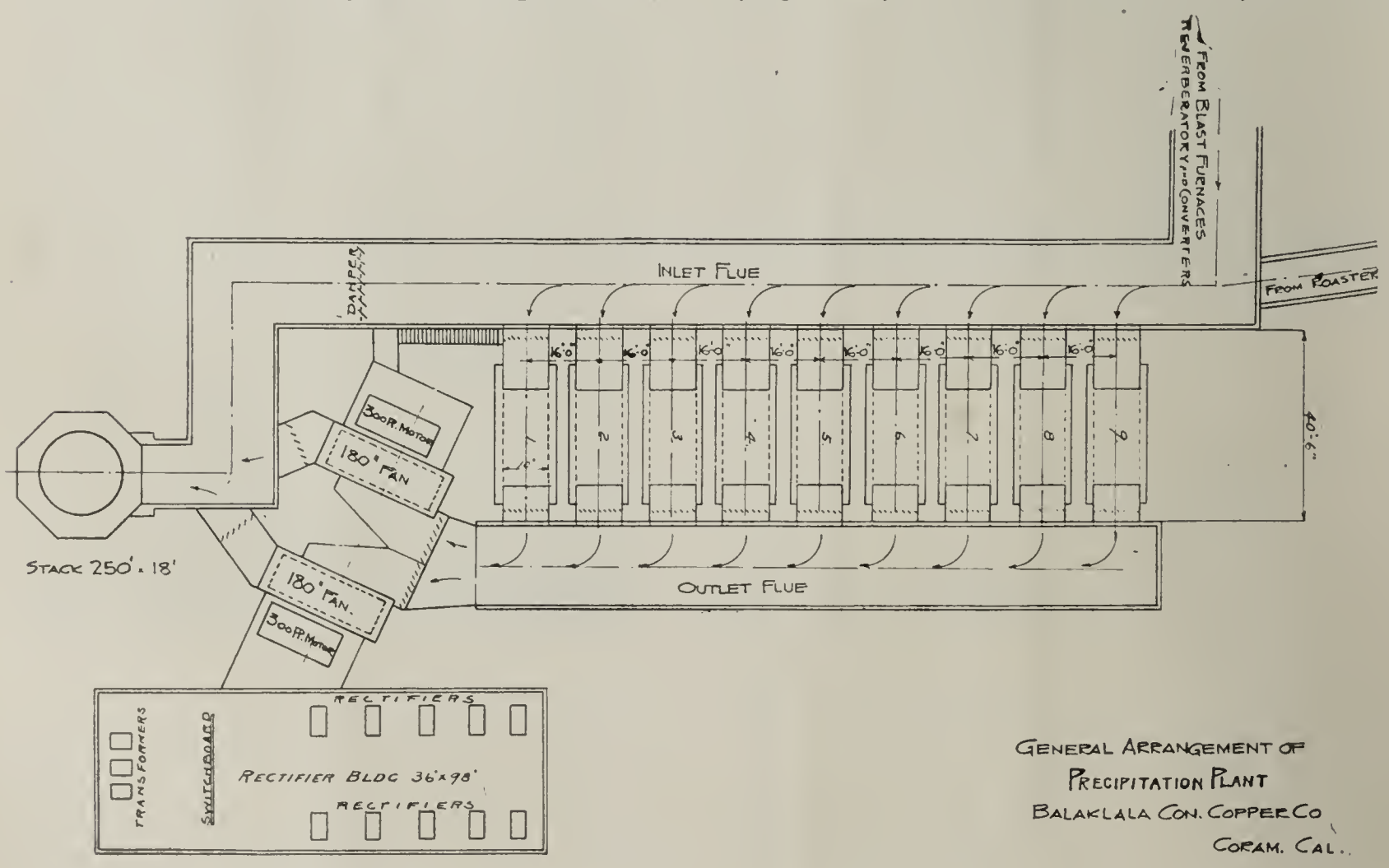


Fig. 21.

Fig. 23 is the interior of the rectifier house or control station showing the general arrangement of the apparatus and wiring. Fig. 24 shows the precipitation units in course of construction, while Fig. 25 is a view over the tops of

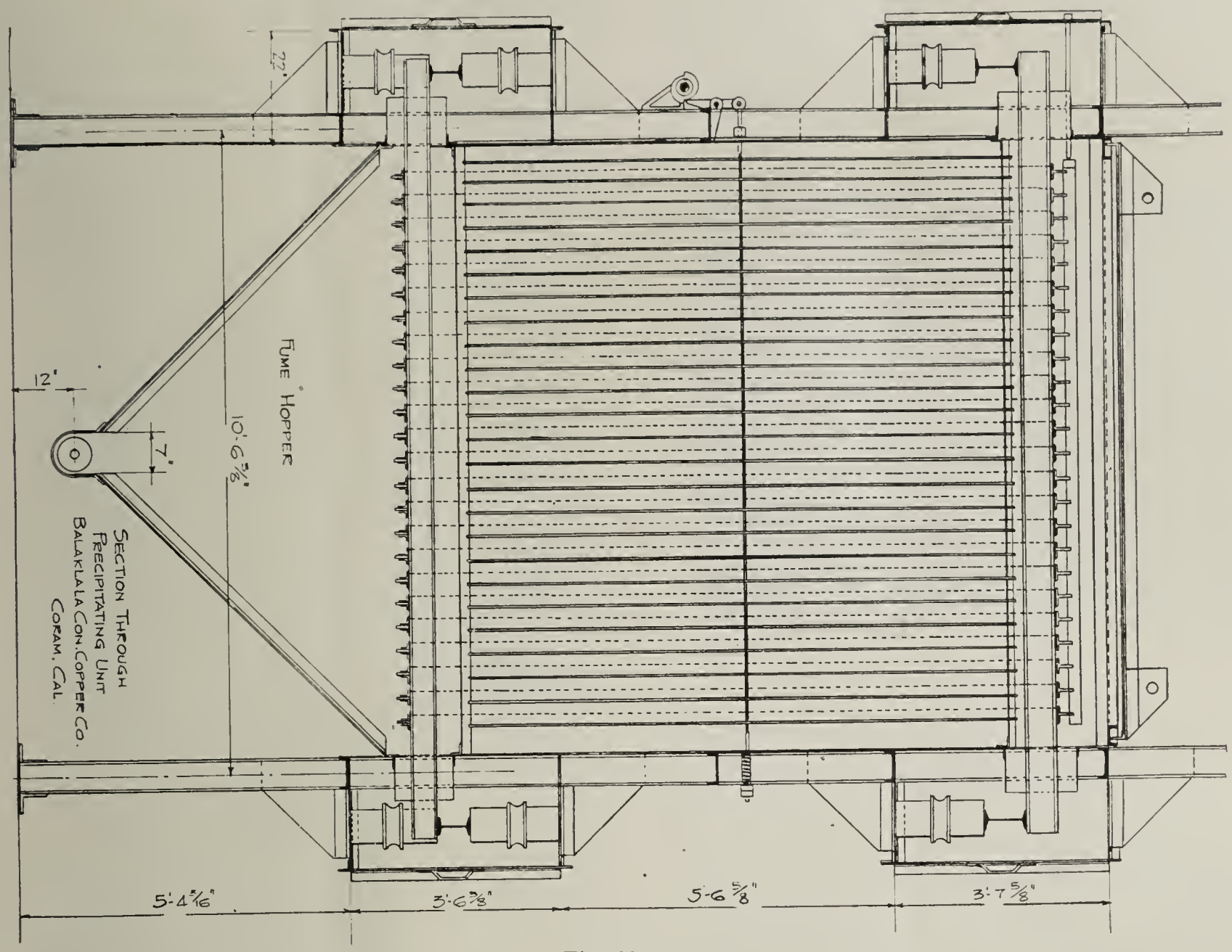


Fig. 22.

six out of the nine units after completion. Figs. 26 and 27 are photographs of the main stack taken a few minutes apart with the electric current respectively off and on.

Filtration tests show that this plant under favorable working conditions precipitates between 80 and 90 per cent of the suspended matter in the gas, the average over the whole period of operation to date being somewhat less. Under present operating conditions at the smelter this represents some 6 to 8 tons of precipitate per 24 hours. Fig. 28 shows this steady stream of precipitated smoke as it flows night and day from the end of the conveyor coming from the units.

The gas treating plant as a whole including flues, fans, motors and electrical apparatus cost up to the time it was

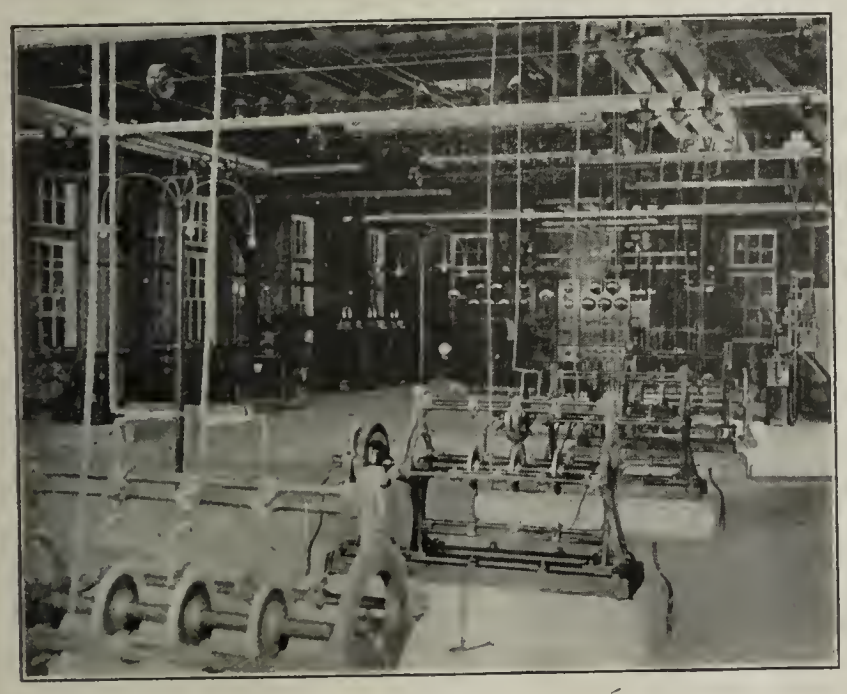


Fig. 23.

Fig. 24.

first put in operation a little less than $110,000. Although many minor changes have since been made none of the larger or more expensive elements of construction have been greatly altered.

The total average power consumption for the precipitation plant at present is in the neighborhood of 120 kws. One man can readily control the whole operation in the rectifier house although as a matter of precaution for a new plant under the high tension here used two have usually been on duty. Two laborers and a foreman are employed on the precipitating units and dust-handling sys-

Fig. 25.

tem, although this can probably be reduced somewhat by automatic shaking devices, since as yet the main efforts at improvement have been directed elsewhere.

The volume of gases to be treated varies considerably with the conditions at the furnaces but at present may fairly be taken as averaging between 200,000 and 300,000 cubic feet per minute, and entering the units at from 100° to 150° C.

One of the greatest difficulties met with in this particular installation has been the maintenance of conductivity in the fine fibers of the asbestos and mica of the discharge

Fig. 26.

electrodes. At ordinary room temperatures these materials readily take on enough moisture from the air to afford sufficient surface leakage for all the discharge necessary, and the same is true at higher temperatures if the gases contain traces of sulphuric acid or other conductive matter, but in the particular gases here met with the high and variable amount of zinc oxide at times robs them of all conductive matter, thus reducing the conductivity of the fibers of the electrodes and seriously effecting their efficiency. The possible methods of overcoming this and giving the fibers a permanent conductivity of their own as well as other details of the more purely electrotechnical matters underlying the whole process will be treated more at length elsewhere as the present article is intended more as an outline sketch of the history and practical development of the work thus far accomplished. Nor is this the place to speculate upon the final outcome

Fig. 27.

of situation between the farmers and the two great smelting plants which have adopted the remedial measures above described, for this is in the end a question for the botanical and agricultural expert, as to whether or not, or to what extent actual damage is still being done, no matter whether this comes from suspended matter or from the sulphur dioxide, which neither the bag house nor the electrical precipitation make any claim to remove. The two smelting companies have done and are doing everything in their power to better the conditions while on the other side the farmers, through the executive committee of their protective association, have earnestly tried to carry out their part in a spirit of fairness to all concerned.

To those who know the circumstances of the many bitter conflicts between farmers and smelters all over this country, with the attendant expense and usual barrenness of results, the present developments in Shasta County present a very suggestive illustration of what may be accomplished in the technical development of our industries by spending the money on experiment and construction instead of all on litigation. Irrespective of the local issues involved the work done at both of these smelters during the past year has been a real and decided step forward in practical metallurgy. Both plants have already sufficient-

Fig. 28.

ly demonstrated the applicability to large scale operation of the principles underlying them to ensure these principles finding a permanent place from now onward in the field of engineering, and each for the particular cases for which it is peculiarly adapted. Before us, of course, still looms the question of the sulphur dioxide and the solution for this on an equally large scale is unfortunately not yet clearly in sight.

Before leaving the subject I cannot but make grateful acknowledgment to those who have worked so earnestly and loyally shoulder to shoulder during the past year and to whose energy and ability such measure of success, as has been met with thus far, is entirely due. Especially do I wish to express appreciation of the courage, determination and ability of Mr. R. T. White, until recently general manager of the Balaklala Company, and now holding the corresponding post with the Braden Copper Company in Chili, in undertaking and carrying through this new developmental work with all its attendant risks under the most trying of circumstances. Fig. 29 is a snapshot of this staff at the works. From right to left on the back row they are: A. H. Trotter, chief engineer; H. R. Hollbrook, chemist; C. A. Van Amberg, master mechanic; R. B. Rathbun, chief electrician; R. House, chief operator precipitation plant; C. S. Hull, osillograph expert, General Electric Co.; and in the front row, from right to left: W. Eaton, engineer of tests; H. A. Burns, my own assistant and co-worker throughout all the work of the past four years; R. T. White, general manager; R. B. Green, smelter superintendent; and the author.

Fig. 29.

Of the other possible applications of the process, one of the most recent to be actively prosecuted is the collection of dust from Portland cement kiln gases. The chief stimulus to this development has again been the nuisance to the surrounding population and its attendant litigation. This has been especially acute in southern California where several cement plants are located in the heart of an exceedingly rich orange country. In the case of the Coulton plant with a capacity of 2500 barrels a day an injunction has already been issued by the court which, if sustained, will close the plant, unless they can control their dust which the court estimates at present at some 20 tons per day. This case differs from that of the smelters in that here there is no question of damage from gases

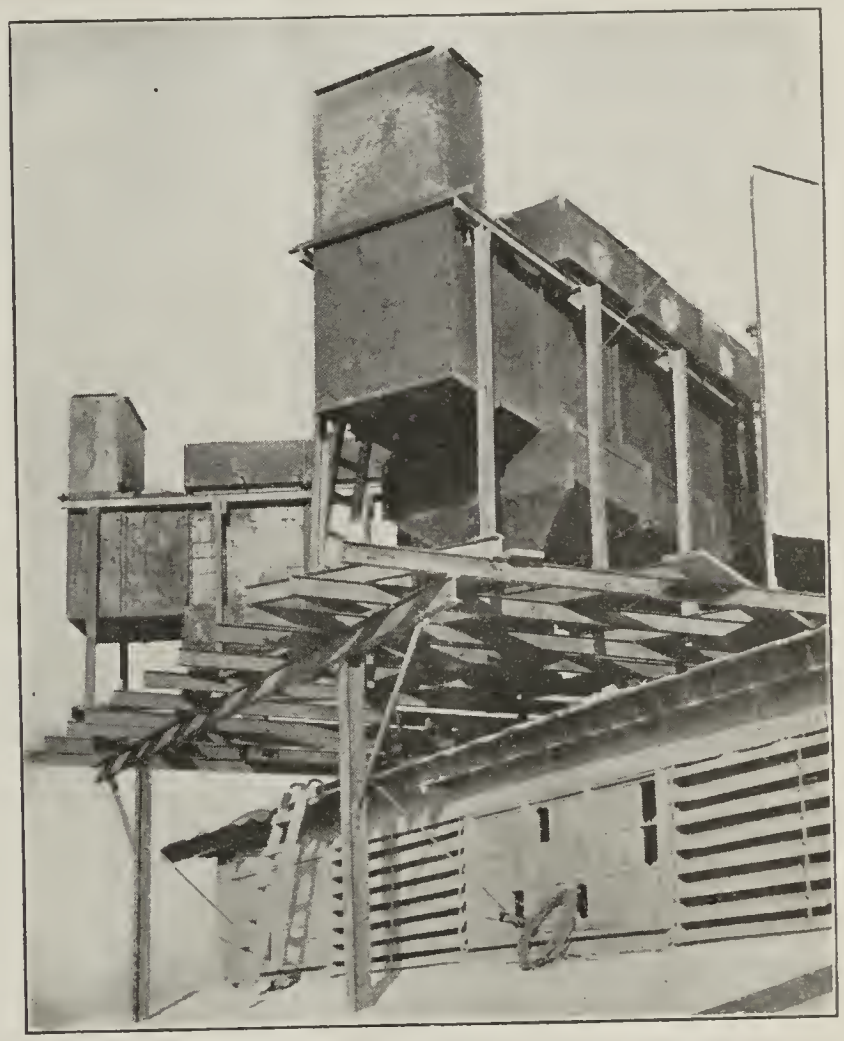


Fig. 30.

but merely the deposition of a large tonnage of impalpable dust of lime and clay.

From the technical side a new condition is here met with in the high temperature of the gases to be treated, which are 450° C. and upwards as they leave the present stacks. The dust itself is furthermore entirely devoid of electrical conductivity, but notwithstanding this it is easily and completely precipitated by the electrodes when these are properly adapted to the new conditions.

Experiments on a scale of a few hundred cubic feet per minute have been carried on for the past few months under the direction of Mr. Walter A. Schmidt, at the Riverside Portland Cement Works, and these have recently been extended to treat a good portion of the gases coming from one kiln. Fig. 30 represents this installation

at its present stage. It is the intention after determining the most advantageous conditions for construction and operation on this kiln to equip the remaining seven kilns accordingly at which time a more complete description of the application of the process will be presented.

Another extensive field in which it is hoped this process may find useful application is the cleaning of iron blast furnace gas for use in gas engines. Outside of the poisonous and combustible nature of these gases and the consequent necessity for keeping the whole apparatus gas-tight there would appear to be no new difficulties here to overcome and steps are being taken to thoroughly test the matter on a practical scale, this work at present being in direct charge of Mr. L. L. Johnson, of Indianapolis.

A question which naturally presents itself is whether this work has any bearing upon the coal smoke problem of large cities. In answer it may be said that for the great majority of cases at present the more logical line of attack would seem to lie in improved methods of combustion, to avoid making smoke in the first place, but in some special instances where such methods may happen to be particularly difficult of application and the suppression of smoke is especially desirable, electrical precipitation may eventually be found of use, for experiments show that it acts upon ordinary smoke in essentially the same manner as upon the fumes and dust above discussed.

EXTRACT FROM THE SYMPOSIUM ON MINERAL WASTES, JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY, MARCH, 1912.

"In the cement industry there is probably anywhere from five to ten per cent of the raw material going off in the form of dust, and that dust is becoming a menace in many parts of the country, so that cement manufacturers are beginning to realize that it is going to be to their advantage to find means for recovering it before they are required to do so. A number of experiments are under way. In one of these I happen to know that the dust, which amounts to many tons per day, carries, in the first part of the collecting flues, a considerable proportion of alkali, but further along where it is collected by the Cotrell process, it is very much richer in alkali, and some of that dust has analyzed as high as 35 per cent soluble alkali, of which one-half was potash. Now it certainly would seem that it might be possible to obtain some potash as a by-product in the cement industry by using raw material rich in potash and making this product cover, wholly or in part, the cost of eliminating a dust nuisance. The insoluble portion of the collected dust could be returned to the kiln."

846 TONS OF DYNAMITE IN SINGLE SHIPMENT.

The largest cargo of dynamite ever brought to the Isthmus on one vessel was unloaded from the Munson Line Steamship Alm, which arrived at dock No. 14, Cristobal, on June 27. The shipment consisted of 29,363 cases, the contents of which aggregated 1,691,191 pounds, equivalent to about 846 tons, and was applied on the requisition for explosives placed in the United States for the fiscal year ending June 30, 1911. The shipment, divided into its various classes, is given below:

Kind.	No. Cases.	Pounds.
60 per cent saltpetre dynamite.....	8,105	676,191
45 per cent saltpetre dynamite.....	3,758	464,000
60 per cent Atlas dynamite.....	8,000	
45 per cent Atlas dynamite.....	9,500	551,000
Total	29,363	1,691,191

USE CONCRETE AT THE CHICAGO STOCK YARDS.

Wooden Structures Are Giving Way to More Durable and Sanitary Ones.

Gradually, fence by fence and trough by trough, is rising a concrete stock yards from one of wooden pens and railings. Only a small portion of the stretches of wooden pens as yet has been replaced with walls and floor of the more sanitary concrete. However, as "Rome was not built in a day," so the yards cannot be rebuilt in any short length of time. But the work is under way, and is one of the best and biggest that the Stock Yard & Transit company has ever undertaken.

For the concrete substitutions, the stock yard company does not have to go outside of its own domain. It owns and controls a plant where various concrete articles of use in the packing-houses are made, and where, also, outside orders are filled. The plant is situated near the entrance to the yards, a half-block off of Exchange avenue. In its work rooms, many men are constantly busy, and finished orders stand ready for delivery. Among them are hundreds of water troughs to be installed in the pens in place of the wooden ones now in service.

Perhaps the biggest piece of work the concrete makers have in hand is the construction of concrete runways or viaducts, over which the cattle, swine and sheep are steered to other pens or to the slaughter houses. Several have already been erected, but there still are many wooden ones in use in various parts of the yards. The new viaducts are wider than the wooden ones. The platforms of concrete are very much longer than the ones they replaced, and can easily accommodate the unloading of 100 cars.

Triangle Mesh Reinforcement is used in all their concrete constructions. Manufactured by American Steel & Wire Company, Chicago, Ill.

CHARLEVOIX ROCK PRODUCTS CO.

The Charlevoix Rock Products Company is putting in a new power plant. The completion of this plant, which is planned for early in May, will represent a cost of approximately $25,000, and the power generated therein will be used for all departments of the industry. The mammoth crusher will be driven by a specially built Fairbanks-Morse, three-pedestal, 150 horsepower motor. All cars of rock from the quarry, which will be loaded by a 70-ton steam shovel, will be handled to the crusher with electrical power, and the present hydrating plant, as now operated by a Westinghouse engine, will be driven in every department by Fairbanks-Morse motors.

Immediately on completion of this power plant and crushing plant, it is planned to double the capacity of the present hydrated lime plant by the addition of two more modern kilns, and it is understood that at a meeting of the board of directors, held in Charlevoix some two weeks ago, that the management was instructed to proceed with all possible haste to the completion of the entire plant as planned, and we are advised that all machinery is now in transit or will be before the end of the present month, and as weather conditions have been such as to prevent the earlier beginning, the work will now be pushed just as fast as it is possible to do it, and it is now an established fact, beyond a doubt, that Charlevoix will have in this plant a year round industry which should be appreciated by the city.

Making Indestructible Hydraulic Cements

By Edward Duryee

Portland cement is an anhydrous and constantly changing compound, solid solution of silicate and aluminate of lime in which the proportion of lime is carried to the highest practicable limit, it is an unstable compound and when water is added it breaks up and the hydrated silicate and aluminate of lime are formed with the liberation of considerable hydrated lime which ordinarily becomes an element of danger in that it reacts readily with acids that may be brought into contact with it in sea, sewage or alkali waters, or it being soluble in water of any kind may go into solution and leach out of the mortar.

A well-known authority on the testing of cements wrote: "It should be borne in mind that all Portland cement, either in mortar or concrete, is partially soluble in fresh water, and to illustrate this point I would state that the Torresdale conduit, in Philadelphia (which is about three miles long, and is designed to carry filtered water for distribution in the city of Philadelphia) was in 1906 pumped out in order to permit an expert examination of it, with a view of ascertaining the cause of leakage, and in the pump pit there was gathered up some 600 barrels of lime. There was about thirty thousand barrels of Portland cement used in the construction of this conduit, and it was thought that the cement was of poor quality, because of this lime; the conduit was pumped out a second time and at that time sufficient lime collected in the pump pit to corrode and choke the pump and put it out of service. When you consider that there were innumerable cracks in the concrete and in the joints of the brick work along this entire three miles, through which water was flowing, it was not surprsing that that amount of lime should have collected in the pump pit, nor is it any evidence whatever of the unsoundness of the cement which was used.

"Portland cement is a tri-silicate and tri-aluminate of lime, unstable, and the addition of water to this compound starts the process of crystallization during which hydrated compounds of di-silicate and di-aluminate of lime are essentially formed. This sets free a molecule of hydrate of lime, which of course is soluble in water, and it was this lime which was dissolved out and which collected in the Torresdale pump pit. The lime, however, is not free lime properly so-called, which is considered objectionable, as the lime is already hydrated and there is no swelling such as would be produced by the hydration of free lime (CaO)."

Another authority wrote the following:

"The points involved are in relation to the general chemical reactions which take place when cement is mixed in either salt or fresh water.

"Properly burned Portland cement is a mixture of silicates of lime with aluminates of lime (the exact relation between these compounds in cement is in reality more complex than this, but has no particular bearing on the present discussion). These compounds are not stable in the presence of water, so that as soon as Portland cement is mixed with water, whether salt or fresh, the silicates and aluminates begin to break up. Free lime is liberated in the course of this decomposition, and though most of the lime re-crystallizes as a lime hydrate and helps to bind the cement together, some of it will necessarily be carried off in solution by the water, particularly if the water is kept in motion by currents or tides. This is an absolutely necessary result of the chemical reactions involved in the setting of cement. It is for this reason that trass or other Puzzolanic materials are often added to Portland cements when the cement is intended for use in sea water, for such Puzzolans readily combine with the free lime and fix it in position.

"Recurring to the question of the decomposition of Portland cement in salt water, I may say that the percentage of alumina contained in the cement is of far more importance than the percentage of magnesia. LeChatelliar has proven, or seems to have proven, that the aluminous compounds present in Portland cement are the direct cause of its deterioration or destruction by sea water, and the French engineers have in consequence restricted the percentage of alumina in Portland cement which is intended for use in salt water. Either such restriction should be placed on the alumina percentage, or else some Puzzolanic material should be added to a cement when it is to be used for harbors, breakwaters or other work in sea water."

It should be understood that only a small portion of the cement is dissolved and leached out even under the most unfavorable conditions, the large proportion sets and maintains the strength and permanence of the mass, as demonstrated by the fact that concrete pipe and quay walls are generally found intact after periods of twenty or thirty years' exposure in fresh and sea water.

Portland cement is an unstable, basic compound of lime alumina and silica and contains the maximum proportion of lime that can combine with the acids at the high temperatures of a kiln, or approximately 2800 degrees F. It contains 3 parts of lime to each part of silica and two parts of lime to each part of alumina. These high proportions of lime cannot be appreciably lowered in the process of manufacturing ordinary Portland cement, as if this is attempted the product after burning and on exposure to the air, "dusts" or disintegrates to an amorphous powder with but little cementing strength. The standard proportions of lime in Portland cements lie between 58 and 67 per cent. A commonly accepted chemical formula reads thus:

$$3CaO,\ SiO_2 + 2CaO,\ Al_2O3.$$

LeChatellier examined thin sections of hardened cement under the microscope and found hexagonal plates of crystallized calcium hydroxide embedded in a matrix of needle-shaped crystals of monocalcium silicate hydroxide. He concluded that the tricalcium silicate in the cement when mixed with water reacts to form hydrated monocalcium silicate and calcium hydroxide, and the calcium aluminate formed the basic hydrated calcium aluminate, the latter accounting for the "setting" and the former for the "hardening" qualities.

Another explanation accounting for the strength of hydraulic cement mortars attributes their binding properties to the colloidal (glue-like or jelly-like) condition of the hydrated lime and silica compounds after water has been added.

The high content of lime in Portland cement exposes its mortars and concretes to attack by acids, and as the alkali soils and sea and sewage waters carry sulphuric and hydrochloric acids in combination with soda, lime and magnesia, they are not therefore permanent always. Most California engineers are acquainted with cases either of pipe lines laid in alkali soils or of sewers in which there has been disintegration of the

concrete due to the reactions of sulphate salts. The almost universal presence of alkaline soil conditions throughout the West renders it desirable that a cement should be proof against these salts, and fortunately this may be readily accomplished by converting the basic Portland cement into an acid Puzzolan-Portland cement, at the same time rendering the concrete denser and more waterproof. This may be indicated by the following percentages:

	Portland.	Puzzolan-Portland.
Lime	62%	45%
Silica	22%	45%
Alumina	6%	5%

The latter is a hydraulic cement containing an excess of active silica in condition to unite with all the lime given off in the ordinary process of the setting of Portland cement so that the mortar contains a much larger amount of the valuable hydrated monocalcium silicate, there is no excess of lime to invite the attack of acids or be dissolved and leached out by water, as is often the case with concretes made with the ordinary Portland cement, in which, if the concrete is alternately wet then dry, there may be observed on the surface a white efforescence of lime that is not only unsightly but the presence of which is evidence that some lime has been leached from the mass of concrete. In the case of concretes kept wet this process goes on continually for an indefinite period, as illustrated in the case of the Torresdale conduit, already mentioned. Often it is not detected as the water usually carries off the dissolved lime, but where the flow of water in a pipe is confined for a long time and then the pipe is laid in wet ground, I anticipate that there will be a deposition of lime in the line from waters that have previously dissolved it from the concrete. This will probably be found to be the case at points in the Los Angeles aqueduct, in which it may be expected that some lime may be dissolved from those portions of the conduit in which ordinary Portland cement has been used, but this will not occur in those parts in which the Puzzolan-Portland cement was used, where there is no excess of lime to be dissolved. There need be no fear, however, that in any case there will be any serious weakening of the concrete or inconvenience from the presence of this lime in the waters; the continuous flow and discharge of the waters will carry off without serious deleterious effect this dissolved lime. The conditions in the aqueduct are virtually the same as those prevalent in all aqueducts, such as the Croton aqueduct of New York, and in no case to my knowledge has there been objection to the water delivered by concrete conduits for domestic purposes on the score of any excess of lime, though it is often noticed that such waters are "hard," indicating that they carry considerable mineral. In a laboratory where test mortars are kept immersed in water it is noticed that if the water is not frequently renewed, it becomes strongly alkaline and the dissolved lime forms a scum on the surface as well as a precipitate in the bottom of the vats. The conditions obtained in laboratory methods of testing, when properly conducted, are such as fairly indicate the comparative values of the cements. The neat mortar tests, however, for strength may be omitted when the sand mortar tests are made, as cement is never used alone and the sand mortar tests are a far more practical and valuable indication of the strength of the cement as used in practice.

In the writer's experience the Puzzolan-Portland cements have always been sound, and the longer the periods of testing the better the comparative showing they make as compared with ordinary Portlands.

The Puzzolan-Portlands need more water in making mortars and show better results if kept damper in the early stages. The mortars exhibit a cumulative, steady improvement. The setting times are about the same as those of the Portlands, the volume of the cement is greater and the color lighter than that of the Portland.

These cements are not the same as those formerly known as Puzzolan cements, which were made in Italy in ancient times and have been manufactured in this and other countries in all times, and which were made by mixing Puzzolan with lime, thereby obtaining a product of slow hydraulic activity, but which produced mortars of excellent permanence, some illustrations of which may be found in Italy today that have withstood weather and sea water action since early in the Christian era. But the cement now advocated possesses the excellences of the modern Portland cements in speedy setting and hardening qualities, with the added characteristics of permanent strength improved resistance to decomposing agents.

In most Eastern cities the ordinances provide for the use of more than one kind of hydraulic cement; not only do such city specifications provide for the use of natural as well as Portland cements, but the often quoted methods of testing recommended by the American Society of Civil Engineers and the American Society for Testing Materials, both provide for the use and testing of both these varieties of cements. The local Puzzolan-Portland product is offered as an alternate to the ordinary Portland, and it is argued that its use should be allowed under proper specifications and conditions in Los Angeles.

CEMENT MILL FOR PERU.

A subscriber to our paper at Lima, Peru, who is now stopping at a leading hotel in New York City, writes us that he has been granted a concession by the Peruvian government giving him the sole right to manufacture Portland cement in Peru, South America, for a term of ten years, during which time no one else is allowed to manufacture the said product in Peru. After his new mill is completed, which will have a capacity of about 250,000 barrels for the first year, the government will establish a high duty on all imported cements.

He owns quarries containing inexhaustible supplies of limestone and shale suitable for the manufacture of a high grade of Portland cement. He can obtain all the electric power which may be required in the mill at low cost from a local power company. For burning the cement there is available petroleum from the Peruvian oil fields at the price of 3½ cents a gallon.

He has raised in Peru already $150,000 and needs $250,000 more which he expects to raise in New York City and if not successful in the latter city he is going to England or France.

He will also consider a proposition from owners of cement mills in United States, who are dissatisfied with low profits or aggressive competition or who have their plants now closed down, to dismantle and ship the machinery to Peru and re-erect there, provided, however, it is a modern up-to-date mill. For prospectus, information, etc., write Cement & Engineering News, 1117 Schiller Building, Chicago.

CONCRETE PRODUCTS.

Hall Concrete Products Company, Philadelphia, Pa., recently incorporated with a capital stock of $25,000.

Water Power Development at Keokuk, Iowa

Of special interest to engineers and others who are interested in the industrialism of the Mississippi Valley is the mammoth project now being carried into execution for developing from 200,000 to 300,000 H. P. at the Des Moines Rapids of the Mississippi river, by means of a dam from Keokuk, Ia., to Hamilton, Ill.

The bed of the river has a fall of 23 feet in the 12 miles between Montrose and Keokuk, Ia., forming what is known as the Des Moines Rapids. The foundation conditions for construction purposes are particularly favorable. The river bed is of solid limestone formation, practically smooth, and with a stream flow at a mean depth of 7 feet offers unusual opportunities for using the cofferdam method for laying dry the sections of the river bed.

The dam will raise the water level about 35 feet at the dam, drown the Keokuk Rapids, submerge a large area of flat land along the banks, and create a still-water pool extending up the river about 60 miles.

Outside Power House Wall, Showing Mouth of Draft Tubes 1, 2 and 3, Iowa Division.

About two-thirds of the submerged area is on the Iowa side, where it will be necessary to raise the tracks of the Chicago, Burlington & Quincy Railroad for a distance of about 9 miles. The normal working head on the turbines will be 32 feet, but the head may be made to vary from 21 feet at high water to 39 feet at low water.

The project of utilizing the power of the river fall at the Des Moines Rapids is an old one, and dates back to 1848. The earlier schemes provided for using only a part of the flow by means of wing dams. During the early '90's the Keokuk & Hamilton Water Co. was organized to build a wing dam and power canal on the east side of the river. Congress granted the necessary authority in 1901, subject to the approval of the War Department. Circumstances then arose which resulted in the company's being unable to finance any of its projects, and the matter remained almost at a standstill until a few years later when Hugh L. Cooper, Consulting Engineer, of New York City proposed to dam the entire river below the rapids, as had been suggested by other engineers who had investigated the project. For this purpose a new company was organized, which took over the rights of the original company. The actual raising of the necessary funds and the prosecuting of the enterprise has been due to the perseverance, energy and engineering ability of Mr. Cooper. His plan received the approval of the War Department and of the Chief of Engineers of the U. S. army. In 1905, Congress passed a bill giving authority to the company to proceed with the construction of the proposed works.

The development has now been undertaken by the Mississippi River Power Co., of Boston, Mass. Mr. Edwin S. Webster is president and Mr. Hugh L. Cooper is the vice-president and chief engineer. The company is carrying on the construction work by its own engineering department and force, under the direction of the chief engineer. The firm of Stone & Webster, of Boston, through its engineering department, has direct charge of the electrical installation, including the transmission and distributing lines; the managing department of this firm will manage the property and will have charge of the sale of power during the construction period.

Allowing for a transmission distance of 220 miles, the plant will be at the center of population of more than four and one-half millions of people. The people of Keokuk and other cities in the surrounding country seem to have a popular interest in "the big dam across the Mississippi," and are already conducting campaigns with a view to developing their towns as industrial and manufacturing centers. The plant now under construction will provide for an output of 120,000 H. P., and a 99-year contract has already been made

for supplying 60,000 H. P. to the street railway and electric light and power companies of the city of St. Louis.

The main dam is of plain concrete, and is 4,278 feet in length. The dam is being built first as a viaduct, consisting of a series of 119 arch spans 30 feet long on piers 6 feet thick, forming a bridge 29 feet wide on piers are 6 feet wide, 30 feet apart in the clear, 42 feet long on the base, and 36 feet at the top. Each 30 foot opening is spanned by an arch of 19 feet radius, having a thickness of 29 inches at the crown. The roadway carried over these arches and piers is 29 feet wide, and will be about 53 feet above the river bed.

The dam or spillway has a vertical face on the up-

Steam Shovel Loading Stone from the Illinois Quarry for the Dam.

crest will be regulated by steel gates closing each 30-foot opening up to the springing line of the arches. the top. The structure will later be converted into a dam by closing each 30-foot opening to the spillway elevation by a dam or weir, so that in the total length of 4,278 feet there will be 3,570 feet of spillway section. The elevation of the water level above the spillway stream side, with a curved crest and "ogee" curve on the downstream side. The upper part of this curve is a parabola, while the lower portion is shaped to a circular curve which ends with a horizontal tangent at the toe. In normal section it is 42 feet wide on the base and 32 feet high from the river bed to the crest.

The foundation work is not difficult, as the bed rock

Construction of the Dam; Dam Traveler at Work Placing Steel Forms.

The gates will be so arranged that they will slide up and down in grooves in the sides of the piers, and will be operated from a traveler running on a track laid upon the bridge. Each 30-foot length of dam is of gravity section, independent of any help from the piers, and is keyed to the piers (by means of grooves in the latter) simply to make the joints water-tight. The has but a slight cover of earth and requires only shallow excavation to secure a solid base for the dam, this base being about 4 feet below the top of solid rock. When the river was reached, as the work progressed from the shore, the piers and arches were built in sections about 1,000 feet in length within enclosures 75 feet wide formed by cofferdams. The river bottom

proper is of solid blue limestone extending to a great depth, and is unusually free from water-bearing seams and pockets of softer material. The character of the rock is tested at intervals by 4-inch drill holes sunk to a depth of about 30 feet. Each hole is tested by compressed air or by water under pressure to determine the presence of any seams or fissures connecting the holes or coming to the surface.

The concrete is a 1:3:5 mixture, using broken limestone crushed to a maximum of 4½ inches in size. No screenings are used. The mixture is made very wet, so that the voids are always thoroughly filled, resulting in a very dense concrete. The batches of concrete average 1½ cubic yards, and are deposited by drop-bottom buckets of this capacity.

The power house will be built parallel to the stream, on the Iowa side. The sub-structure will be a practically solid mass of concrete 1,700 feet long and 123 feet wide, with its floor 45 feet above the bed of the river. In this mass of concrete will be cast the wheel pits and the conduits for the passage of the water to and from the wheels. The superstructure will be of steel frame construction with walls of brick and concrete, and a tile roof. It will be about 125 feet wide and divided longitudinally by a concrete wall forming a series of arched recesses in which the transformers will be placed. The river side of the building will be the screen room. The entire building will have an upper story, in which will be placed the oil switches and other electrical auxiliaries.

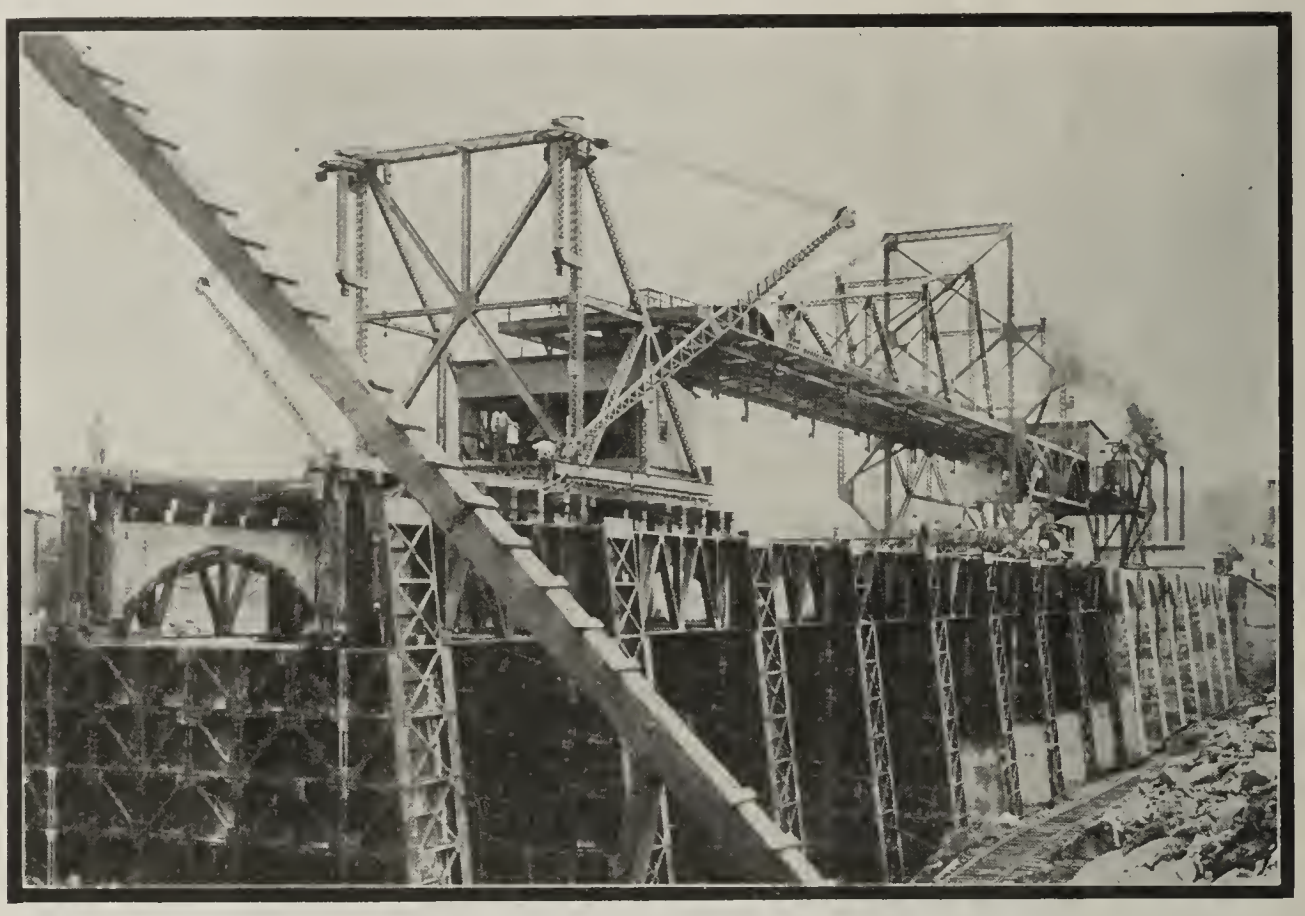
There will be 30 generating units and 4 exciter units, but the first installation will consist of 15 generators and 2 exciters. Each main unit will consist of a 7,500 K. W. revolving field alternator (the equivalent of 10,054 mechanical H. P.) mounted on the upper end of a vertical shaft whose lower end carries a single-runner turbine of the Francis type. The revolving parts will be carried by a roller bearing, which will be interchangeable with an oil-pressure thrust bearing.

The intakes will be on the west side of the power house, and will take water from the forebay formed between the building and the shore. To exclude logs, drift, and ice from the forebay, there will be a con-

Excavating Trench for Toe of Dam. Sullivan Rock Drills Shown in Center.

Beginning Work on the Dam; Overburden Cleared Away on Both Sides. of Trench; Channeler and Drills Excavating.

crete fender or guard pier 2,340 feet long, extending upstream from the power house and curving in towards the shore. A 300-foot opening is to be provided for navigation between the end of this pier and the shore, and except during the navigation season this



Progress on Dam, Illinois Shore.

will be kept closed by a floating boom built of timber trusses about 5 feet deep. The pier will be 6 feet wide on top and 18 feet on the bottom; and will have 21 submerged openings 100 feet wide to admit water from the river to the forebay.

Beginning of Power House Excavation on the Iowa Shore. Sullivan Drills Used on This Work.

The work of constructing the power house is being done within an area of about 35 acres of the river bottom. This area was unwatered by enclosing it with a cofferdam and pumping out the water by the use of centrifugal pumps.

The cofferdam is composed of cribs of square timber, the cribs being 24 feet long and 16 feet wide, with the tops about 15 feet above the river bed. To determine the form of the rocky surface of the river bed at each crib, a raft the same size as the crib was moored in position and a sounding pole used to get the depth along each side. The bottom portion of the crib was then built on shore and cut to the shape shown by the soundings. This portion was then launched and floated to its site, where it was held in position by ropes while the upper portion was built upon it. Its own weight sunk it to the bottom, and when finished to the proper height it was filled with loose rock to hold it in position. When all of the cribs for the cofferdam were in place, the 12-foot openings between

them were closed by lowering stop-logs and heavy planking into place against the corner posts of adjacent cribs. A sheeting of vertical planks was then spiked against the cribs and the stop-logs of the outer face of the cofferdam, each plank having been driven down to the bed-rock before it was spiked. The cribs were braced on the inside by diagonal timbers notched into the bed-rock. To make a water-tight face, clay and earth were deposited outside of the sheeting, being dumped from cars on a track laid along the cribs. This track was also used for the railway cars carrying the crib timbers. The fill was then faced with loose rock dumped from cars, as a protection against the wash of waves and current.

Main Dam of Illinois Division, August 21, 1911.

The cofferdam was not built to full maximum flood height, as this would have been very expensive and would have necessitated raising all the plant to an inconvenient elevation. It was considered better and more economical to allow for possible overtopping and flooding of the work by exceptionally high floods. This would do little damage and would result only in a little lost time.

The same type of cofferdam construction is being used in building the dam across the river.

Under the Dam Traveler; Channeler and Sullivan Drills at Work in Trench.

Steel Forms for Concrete Work; View Beneath Traveler.

Navigation past the works will be provided for by a lock and basin on the Iowa side. This will be located near the south end of the power house and will form a part of the closure of the forebay. The old govern-

ment lock and canal will be submerged by the new water level. The new work includes a single lock of 40-foot lift, which will have a chamber 400x100 feet, with 8 feet of water on the upper sill when the water is drawn to its extreme limit. Alongside the upper entrance to the lock will be an entrance 110 feet wide admitting to a basin 150x460 feet to be used for dry dock purposes.

A special feature of the construction work is the use of steel forms on a large scale, especially so in the casting of the piers and arches of the dam. The steel forms are built up of structural steel shapes and faced on the inner side with steel plates. A good idea of this steel form construction may be obtained from the accompanying views. The working plant includes ten complete sets of pier and arch forms. All forms are left in place for about a week, with five days as a minimum. The record for speed of erection of the forms of a complete pier and arch is five hours and twenty minutes.

One of the most interesting features of the construction work is the use which is being made of travelers for handling both the concrete and the steel forms used in the dam construction. It is well known that there has been a great gain in economy, both in cost and in time of erection, brought about in bridge construction by the use of the traveler; but this is perhaps the first case where a traveler has been applied to the work of dam construction. This application is made possible by the fact that the structure is a bridge as well as a dam, and by the particular method of operation by which the dam is being constructed. There seems to be no doubt that this application of the bridge traveler to the construction of the dam is responsible, more than anything else, for the extremely rapid progress which is being attained. The organization of this immense work is so complete and systematic that it is now several months ahead of schedule and the cost is running under the original estimates, notwithstanding the fact that the overhead charges are so large that speed is made subservient to cost in many instances.

One of the unique incidents connected with this work has to do with civic affairs. The cities of Keokuk and Hamilton had appropriated and paid to the promoting corporation $2,500 and $1,500 respectively to use in its preliminary work. After the company was turned over to the Mississippi River Power Co., which paid this $4,000 as a part of the total expenses, every cent of these appropriations was returned to the city treasuries involved.

Dam Traveler and Illinois Construction Plant.

It is believed by students of municipal government that this incident is without parallel in this country. But it is perfectly illustrative of the spirit which has actuated everybody connected with this enterprise from the beginning to the present moment. Almost every acre of the two million dollars' worth of land submerged was bought from the many owners at an agreed price without any being taken by condemnation proceedings. Everybody in Keokuk helps whenever called upon, and the Lee county authorities act for the good of all concerned whenever it is needed. Once, when Mr. Cooper telegraphed from New York asking for a certain ordinance to please some prospective stockholders, a special meeting of the council passed it that evening and notice that it was accomplished lay upon Mr. Cooper's desk when he got to his New York office next morning. The water power company has met this spirit half way. It heartily co-operates with the commercial organizations of the near-by cities and towns. It spends a good deal of energy in a practical way, as

First Section of the Power House Site, Unwatered by the Cofferdam.

in the building of roads and the salvage of low lands. It is concretely and somewhat expensively assisting in the commercial uplift of the territory surrounding the water power site at Keokuk. Chief Engineer Cooper, with the construction work upon his shoulders, gives liberally of his time and energy to lectures, including stereopticon pictures of the works.

The construction of this great power plant marks a new era in the industrialism of the Middle West. The plant is in the center of the Mississippi Valley (now fundamentally an agricultural district) with its immense consumption of all kinds of manufactured goods. The Mississippi gives an outlet to the Panama Canal and the high seas for export trade. The river navigation controls freight rates and keeps them low for domestic shipments. The economic values resulting from the building of this water power should increase very appreciably the assets of the commonwealths adjacent to it.

As to what kinds of manufacturing can profitably be carried on within a reasonable power transmission distance, few problems, are presented. Proximity of nearly all raw materials, cheap, easy and adequate transportation, and the location in the center of the Mississippi Valley market, with a water route to the ocean, are essentials attractive to almost all forms of manufacturing.

THE REMEDY FOR DAMP WALLS.

A means of preventing the penetration of dampness and water through structures such as foundations, cellar walls and floors, tunnels, dams, reservoirs, swimming pools, and other concrete work, has often proved a difficult problem. Concrete is porous because of the voids between its contents. Under a glass a fresh surface of fracture shows that the pieces of stone and sand are smeared over with a very thin coating of cement wash with considerable remaining voids. Through these voids water will pass by gravitation and capillary attraction. To make the concrete waterproof, two principal methods have been tried. One is the filling of the mass throughout with a non-porous substance, or the treating of the surface so as to make it watertight. The objection to the surface coating is that it is easily broken or rubbed off in spots and is too weak to be serviceable as a waterproof coating should be. It is not satisfactory to waterproof the mass of concrete in such a way as to leave this important property at the mercy of continued watchfulness and renewals. A satisfactory waterproofing must be as durable as the concrete itself.

A waterproofing compound which is mixed with and becomes an integral part of the structure is known as Ceresit, a cream-white paste of about the consistency of butter. Ceresit paste is simply added to the water used in mixing the mortar or concrete and penetrates with the water to all parts of the concrete or mortar, assuring a permanent waterproof and dampproof structure. Among the properties of Ceresit may be mentioned that in addition to preventing penetration of any moisture whatever, it does not affect the original strength of the cement, and is so inexpensive as to make it a means of real economy. The many structures in which it has been used are continual evidence that it prevents the peneration of water, even under heavy pressure, as in dam, reservoir, bridge and similar work.

The Ceresit Waterproofing Co., Clark and Adams streets, Chicago, have published a pamphlet, sent free on request, illustrating many structures whose walls have been waterproofed in the manner described, and giving a list of local agencies.

KANSAS CITY SHOW A SUCCESS.

"The show has been successful beyond all expectation," said R. Crawford, acting treasurer of the show and publicity manager for the Chicago Portland Cement Company. "We will positively be back here next year. You couldn't keep us away. Both from the standpoint of attendance and the interest shown by visitors, this show compares more than favorably with the Chicago and New York shows.

"What the management likes particularly is the infusion of new blood into the show. The western cement manufacturers, particularly the Kansas mills, have joined us here. We have also met a class of visitors that we had become used to meeting in the Eastern shows. I refer to the practical builder who exclaims, "But I didn't know you could make that out of cement." The first Kansas City cement show marks a new era in the use of cement in the West. We have met and to an extent educated many men from all parts of the West, men who didn't take in the Chicago and New York shows.

Builders Were Interested.

"We have been pleased with the interest shown by the home builders and by contractors who build residences or public works. Unless I am much mistaken Kansas City is going to have a good many cement houses within the next few years, whole additions of them. We know this from the many purchases of cement making and mixing machinery made by Kansas City people.

"Kansas City's business interests will be given a new impulse by the show. Within the next few weeks there will be opened a number of establishments which will handle cement machinery, mixers, molds and the like."

"I am surprised at the great success of the show," said William Walter Smith, field agent for the Association of American Portland Cement Manufacturers, just before leaving the city yesterday. "I had expected great interest, but not the amount of interest that was manifested here."

"Great, simply great," was the verdict of Ward B. Akely, brother of C. E. Akely, inventor of the "cement gun," and himself the representative of the General Cement Gun Company. "Kansas City has given us a royal welcome and the interest in the show indicates a new era in the cement business in the West."

Are Coming Back Again.

Chas. H. Merillat, of the Merillat Culvert Company, who describes himself as the "happiest man in the show," is also enthusiastic over the success of the project. "We're all coming back to Kansas City," he said. "I've made all the shows, and none of them can beat the reception we have had here. And I believe the show has opened the eyes of Kansas City and the Southwest to some new things that can be done with cement."—Kansas City Journal.

LINK BELT COMPANY.

We are advised that the Link Belt Company of Chicago and Philadelphia, well known manufacturers of the original "Ewart" chains and "Flint-Rim" sprocket wheels, now maintain a corps of expert engineers experienced in the design of economical conveying and screening systems for gravel and crushed stone plants. The Link Belt system of washing sand and gravel produces the highest grades of material at a low operating expense. It has been extensively adopted by the leading producers of washed gravel.

Building Cement Plaster or Stucco Houses

Suggestions As to Construction with Special Regard to the Ornamental Features

By P. P. Comoll

In building a house, it is conservative to estimate that the contents will be worth at least as much as the house itself, and that there is upon the house the double duty of protecting not only itself, but also of sheltering that which it contains. Therefore, in the construction of the house, it is demanded that the materials and the methods shall be the best that human wisdom can devise, taking into account economy, durability, protection, appearance and general desirability. Of course, we contend that in the way of material the best is cement; and it is the object of this Association to exchange ideas as to what may be best in the way of methods of construction, and thus promote the more general use of concrete.

Economical advantages are always to be considered; and in this case it certainly is obvious that in ultimate cost the advantage is with concrete, on account of its durability, owing to freedom from decay, its certain protection to the contents of the building, its saving in the use of paint, its equalization of temperatures between summer and winter, and many other features. The original cost, of course, will vary according to the location of the property or the design of the structure; but it will be found that in many forms concrete may be used nearly as cheaply as perishable wood. Even if a house be constructed merely as an investment, a concrete building will be found to outclass any other, since it may retain is original value for centuries, while other forms of construction rapidly deteriorate, demanding constant expenditure for repairs.

There is lively interest among those studying modern building methods, in the controversy between the advocates of hollow wall construction and those who favor solid walls of reinforced concrete for factories, warehouses and structures of like character. The writer is firmly of the belief that the hollow wall, constructed by tying two walls together with pieces of iron or heavy wire at regular intervals, while originally more expensive, is the best for all climates, as the air space thus formed acts as a barrier to excessive heat or extreme cold. Furthermore, it can be safely plastered on the inside without fear of frost or moisture penetrating—advantages which more than offset the slight additional cost.

The hollow wall is made in the same manner as the solid wall construction, except that the core is built in sections about two feet high, which rest upon the irons or wires used to tie the walls together. These irons should be long enough to extend half way through each wall, and the distance between them will be governed by the strength required of the structure. There should, however, be a course of these irons every time the core form is raised. The top and ends of each wall should be made solid the last three or four inches, thereby forming a dead air space, which must be continuous and not partial.

Cement Plaster Construction.

If it be desired to have a house which can be cheaply built and yet have the external appearance of a solid cement structure I would recommend the following methods:

Use 2 in. x 6 in. studding for the outside walls, instead of 2 in x 4 in., standing 16 in. center to center, bridged every four or five feet. First, cover the outside with ¾ in. sheeting boards not too close to each other, well nailed. Next put in two thicknesses of roofing paper, held by furring strips nailed at the studs. On this paper layer, staple expanded metal lath. Then the wall is ready for the cement plaster. By this method you will be able to complete the interior, and do all the hammering and jarring necessary, and allow the wood to shrink and the house to settle before the outside is commenced, and thus eliminate the danger of cracking the concrete; and it also will do away with outside wood finish at the doors and windows, and permit the same treatment to be given at the final finish as on any other permanent construction. The cement plaster is an absolute protection for the metal lath, being moisture proof.

To the wood structure, apply the scratch coat about ½ in. thick and press it partly through the openings in the lath, roughing the surface with a shingle or a piece of metal lath. Allow this to set at least five hours, according to the weather, before the second coat is put on.

As a rule, two coats are used for a plain surface; but if a more artistic effect is desired, three coats are necessary. In making up the specifications for this class of work, the number of coats should be stated instead of the thickness, because Portland cement will stand only a limited quantity in any one coat, as is the case with paint. If it be put on too thick, it will either slide or crack when setting, according to the condition of the surface.

If Tyrolean rustic (or rough-cast) be desired as a final finish, it is necessary to treat the second coat accordingly with the proper tooling to indicate the margins at corners and openings, window sills, caps, water table, belt courses, panels and whatever trim may be desired. This, of course, must be done at least one day before the rough-cast is applied.

In rough-casting, start at an upper corner of the building by wetting the wall thoroughly. In the meantime, the helper mixes the plaster in the proportion of one and one-half parts of sand to one part of cement. This mixture should be taken to the place where it is to be used, and then wetted in a small box to the consistency of a very thick cream as needed, being kept well agitated.

This mixture must be put on with a broom made of fine twigs. Standing about 2 feet from the wall, the broom is dipped in the mortar and then struck on a round piece of wood held in the other hand. This allows the mortar to reach the wall in a spraying fashion, like raindrops. Repeat this by going backward and forward until the surface comes out in a rough form, or until it has come to the desired color. With this method it is possible to make three or four colors from the same mixture, wherever you intend to have them, in producing designs on the facade of a building, or on any other surface.

Cement plaster can be applied successfully to any walls or surfaces made of any material, provided special precautions are taken in preparing the surface properly, so the plaster will adhere and not crack or scale off. This work should be done by an experienced cement plasterer. Owing to the difference in the nature of stucco and lime plaster, it is very important that men engaged in working with them should understand the chemical actions of the three different materials as used for exterior work in cold climates. Ignorance in these particulars is part of the reason why so much of such work has gone bad.

Preparation of Surfaces.

If a brick wall has been laid up with lime mortar, it is

necessary that the joints be raked out to the depth of half an inch, and so with any masonry laid up with any mortar except concrete. Then clean the surface thoroughly by using plenty of clean water so as to soak the wall.

As a rule, two coats are used—the first a scratch coat composed of two parts of clean sand to one part of cement, with about ten per cent of hydrated lime. The thickness of this coat should be about 3/8 in. to 1/2 in., and it should be left rough.

Care must be exercised in applying the second or last coat, to see that the mortar in the previous coat has reached the same degree of setting or suction over the particular wall area that is to be finished on that day, as this precaution is necessary for any kind of surface, to insure the desired uniform shade in the last coat.

The prominence of reinforced concrete for residence and building construction has brought about a demand for decorative material with which to relieve the monotonous appearance of the unbroken gray color conspicuous in all concrete surfaces. While it is true that much work of a very plain character, in form as well as in surface, has been executed in concrete, yet all have an objectionable sameness of color.

For the exterior decoration of concrete, common brick, block, stone or wood structures, nothing can excel Portland cement plaster. In its adoption is found a medium yielding any scheme in color or design. It is impervious to climatic conditions, and as durable as the structure itself when it is done by practical workmen trained for the task.

A simple and inexpensive method of securing an artistic effect consists in covering the outer surface of the building with rough-cast of Portland cement mortar. When it comes to details, it is desirable to have the trimming at the openings, water tables, belt courses and marginal corners to give expression to ideas of architectural beauty and workmanship. The concrete house conveys primarily the impression of strength, and it calls for the same qualities in all its various attributes, including the roof.

This humble material, so replete with possibilities, but as yet so little understood, is manifestly destined to take an important place in the ornamentation of our future buildings, and must therefore strongly influence their design. If our designers will devote themselves with sufficient energy to the demands of this new material, as it so well deserves, they will discover a new architecture that will be full of life and character, strength and dignity, which will go to making up a living style.

It is to be regretted that the average cement user in the Middle West knows so little and cares less concerning its development. The time is not far distant when a cement worker must learn his trade, the same as is required in any other profession, in order to create a forced demand for his line of business in competition with the old orders of construction, and to create a better taste and to increase its appeal for more classical work.

The writer is of the opinion that the invention and use of machinery to turn out stereotyped units for alleged cement "construction," whether in the way of Edison's "poured houses" or in the way of supplying concrete blocks, have a retrogressive instead of a progressive tendency in the real art of using this splendidly plastic material. It seems that so long as the machine supplies the blocks which make them a living, a large proportion of cement users do not care to improve the conditions of their craft, and in too many cases the art of it lapses and withers.

In too many localities there are men, without previous experience in the business, who procure a few books on the subject and then go into "cement construction." Of course, technical or book knowledge is helpful, but practical experience is the great overwhelming necessity in order that the best results shall be secured.

My recommendation for the benefit of him who is inclined to take up this useful profession of cement construction, which as yet is only in its infancy in this country, is that he should perfect himself for the business through practical demonstration, assisted by such knowledge as he may acquire from books or from consultation with those who may have had experience. Already the hour has struck when winners in any occupation or profession must be experts in their line to accomplish the results the world demands.

CEMENT FOR MODERN DAMS.

No other engineering project in the world has required such a vast quantity of cement as the Panama Canal. Not only does it require several million barrels for the locks and dams, but many hundreds of thousands of barrels for dry docks, piers and other structures for the accommodation of an enormous amount of shipping. Much concrete will also be used in lighting the canal. All of the big range lighting towers and beacons through the canal will be built of this material.

Likewise, the banks of the great Culebra Cut will be lined with cement. This will be literally shot into position, a cement gun being used for that purpose. This gun resembles an oxyhydrogen blow pipe. On a large truck are mounted two tanks, one filled with water and the other with mixed cement and sand. Both of these are expelled under heavy pressure. They meet near the nozzle, where the mixing process goes on, and from where it spouts in a stream against the bank of the canal. Here it is allowed to dry, when it becomes as hard as adamant.

One of the most recent of the great engineering projects of the world is the building of an addition to the famous Assouan Dam, which holds in check the waters of the Nile. This dam is being raised by twenty-three feet. It formerly furnished over a quarter of a trillion gallons of water for the irrigation of half a million acres of land in the Nile Valley. With the additional height the amount of water stored and the number of acres irrigated will be trebled. The use of Portland cement makes it possible to add a sub-structure of this kind and securely to tie it onto the original dam.

Another victory for concrete will be the construction of the Arrow Rock Dam in the Boise River Canyon of Idaho. This dam will be 350 feet high, making it the highest structure of its kind of the world. The one nearest approaching it in height is the Shoshone Dam at Cody, Wyo., which is 326 feet high. The Arrow River Dam, like the one at Cody, is being built in connection with a government irrigation project.

MAKE CONCRETE BLOCKS.

Churchill Bros., Malvern, Ia., have made about 4,000 concrete building blocks this winter at their plant. The building in which the plant is located is not plastered, but is lined with tar paper and by keeping fire all the time they have been able to keep the fresh blocks from freezing even during the coldest weather. And by being able to make blocks in the winter can work on stormy days, when one could do but little at outside work.

CONCRETE HOTEL BUILDING.

Architect Harrison Albright, Los Angeles and San Diego, has been commissioned to prepare plans for an 11-story and basement reinforced concrete store and hotel building on the east side of Hill street between Fourth and Fifth streets, for E. P. Clark, 637 Consolidated Realty Bldg.

Rock Crushing Plant, Kensico Dam

By Samuel W. Traylor

The Kensico dam, which is being built across the bed of old Lake Kensico, in Westchester county, New York, is to be used to create a storage reservoir in connection with the new Catskill water supply of New York City, and will retain sufficient water behind it to ensure a supply of about 45 days to the city, in case of an accident to the system between Lake Kensico and Ashokan. The dam itself is to be built of cyclopean masonry faced on its upstream side with concrete blocks and on its downstream side with cut stone, and will contain over 1,000,000 cubic yards of masonry. The geological formation of the valley, which at the point of the dam is 1,900 feet wide, is rather peculiar, being eroded out of a vein of dolomite, about 400 feet thick, which lies between the gneiss of the easterly hill and the mica schist of the westerly hill, and at the point of contact there is the badly decomposed and disintegrated condition of the rock naturally to be expected. This will make necessary an excavation of about 130 feet below the present surface of the valley to ensure a dependable foundation and at this point the total height of the dam will be about 300 feet.

For the construction of this dam the contractor, H. S. Kerbaugh, Inc., is now installing a very large rock-crushing plant, which will be located near the dam site and will take the rock directly from quarry and crush it to the desired size for the concrete work.

Quarry and Equipment.

This quarry and plant are located at Valhalla, in the suburbs of White Plains, N. Y., on the New York Central R. R., about thirty miles from New York City. The quarry extends along the edge of a granite reef or ridge 3,000 feet.

The pneumatic drills used in quarrying are of the very largest made for this purpose, having a capacity for boring a 5-inch hole to a depth of 20 feet.

There will be used four 90-ton, 4-cubic yard steam shovels in loading the rock into the quarry cars.

The transportation facilities consist of four 40-ton locomotives, each handling a train of 15 to 20 cars, each car having a capacity of 8 cubic yards.

As the trains are loaded by the steam shovels at the quarry they are hauled into the crushing plant, where the cars are quickly dumped by an ingenious device and the rock discharged into a chute leading directly to the initial crusher. The train is then hauled through the crusher building and returned to the quarry over a separate track.

Crushing Plant.

The layout of the crushing plant is shown in Fig. 2. The progress of the rock through it is as follows: Quarry rock is brought in on the high-level tracks and is dumped into the initial 5x7-ft. crusher, which reduces the rock to a size of 9 inches and finer. It then passes over a grizzly with 4½-in. openings, the undersize or through product going directly to the elevator, while the oversize is run through the second crusher with an opening 3x6 feet, reducing it to 4 inches and finer. This product, with the undersize from the grizzly, then goes to the elevator and is raised to a 7x30-ft. screen. This screen is so designed that all material ¼ inch and finer is removed for a sand product and stored separately, while the coarse aggregate,

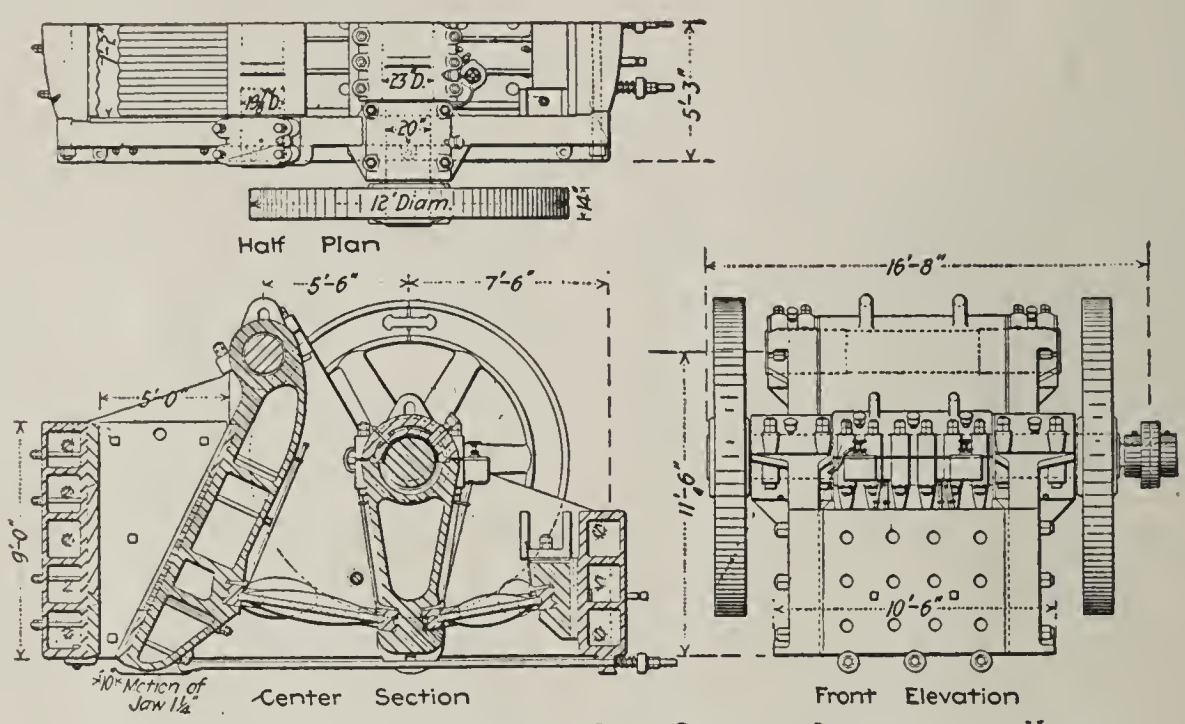


FIG. 1. DETAILS OF 60x84-IN. BLAKE JAW CRUSHER INSTALLED AT KENSICO CONSTRUCTION PLANT

or stone between ¼ and 2½ inches is distributed by a 30-inch conveyor into a 10,000-ton storage bin, located at the lower end of the plant directly over the outgoing railway tracks. The oversize from the screen goes to a small bin, which is equipped with a 28-inch steel pan feeder and is delivered uniformly to a heavy-duty 60x30-inch crushing roll; the product from this roll being returned to the same elevator and screen.

The storage bins are so constructed with bottom- and side discharge gates as to permit of loading standard-gauge cars running under the bins as well as at the sides, preventing any congestion at this point and making available the full storage capacity of the bins by reason of the many points from which the product is discharged.

From this brief description the simplicity of design and economy in operation will be noted, as well as the small number of individual machines required for so large a capacity. The equipment of the crushing plant is as follows: One jaw crusher, with a clear opening of 5x7 feet; one jaw crusher with an opening of 3x6 feet; one continuous bucket elevator, with buckets 42 inches wide by 18 inches deep by 19-inch

projection; one all-steel 7x30-feet revolving screen; one 60x30-inch heavy duty crushing roll.

It will be seen that this plant presents interesting features, from the fact that it would require not less than nine gyratories, if that type of crusher were used. Even though a No. 21 gyratory were used as the initial crusher, all rock coming from the quarry would have to be broken to a size of 3 feet or smaller before it would enter the crusher. The necessity of breaking the quarry product to 3 feet and smaller adds materially to the cost of operation of a gyratory plant. The initial crusher, as designed, however, will take any piece of rock that will ordinarily come from the quarry, and this greatly reduces the cost of quarrying, handling and crushing.

the plant by accident, and so avoid any possibility of congestion from this source.

There are also two main delivery tracks running directly through the building, and heavy chutes extending from both tracks to the initial crusher. Only one of these tracks will be used at a time, the other being purely an auxiliary to be used in case of mishap or obstructions, when it may be put into commission, thereby making it unnecessary to close down the plant. This track equipment is so arranged, also, that the initial crusher can be temporarily closed down and the rock fed directly to the second crusher, this being especially desirable should the rock from the quarry be running in small sizes, such as would enter the second crusher without difficulty, thus not only saving

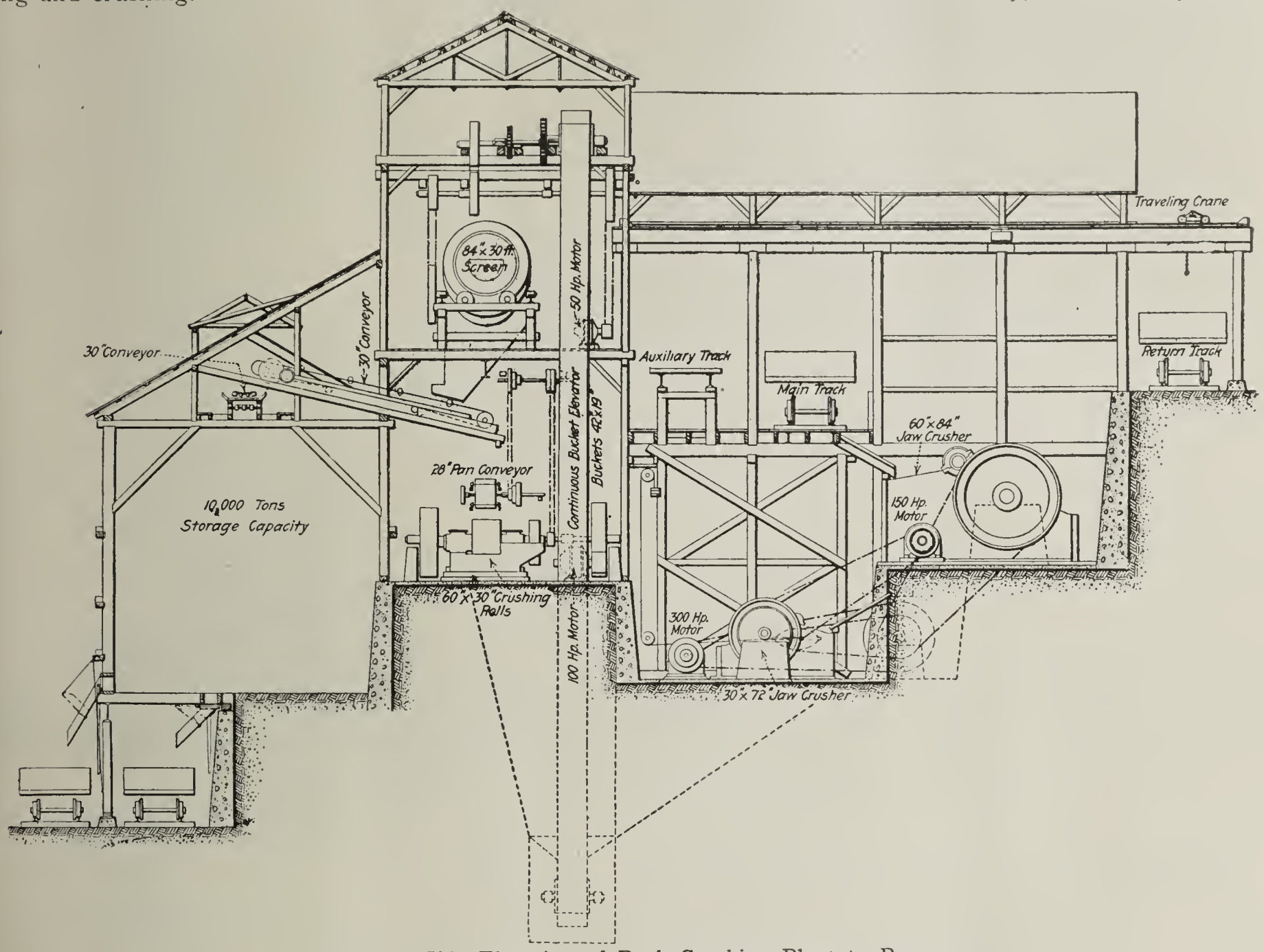


Fig. 2. Side Elevation of Rock Crushing Plant to Prepare Concrete Stone for the Kensico Dam. (Rock enters from quarry at right hand track and leaves storage bins at left hand tracks.)

The matter of repairs is of small moment in this plant, as it is estimated that all wearing parts will last for two years or more in continuous operation without renewals.

Some of the novel features of this plant are the trackage arrangements and the facilities for loading and unloading all products during construction, there being provided a standard-gauge track along the upper side of the plant, with a crane running over this track and into the crusher building, facilitating the removal and placing of the heavy machinery directly from the railway cars. When the plant is completed this same track will be used for returning the empty cars to the quarry. The crane is so located that it may be used to advantage, if necessary, for removing pieces of rock more than 7 feet in size which may have gotten into the large crusher, but considerable expense in the matter of power, and this arrangement also permits, of course, repairs or changing of wearing parts on one machine without the necessity of closing down the whole plant.

Unloading Device.—There is provided a special unloading device which is supported by the crane extending over the large crusher, delivery tracks and chutes. This device consists of an air lift, the cylinder being 20 inches in diameter, to work under an air pressure of 80 pounds, and having a lifting capacity of ten tons. As the cars pass in front of the chutes, one man can quickly dump them by hoisting one side of the car, making a very economical arrangement.

Large Crusher.—The large or initial crusher in this plant has a jaw opening of 5x7 feet, and will easily take a stone weighing ten tons and reduce it within one

minute. This crusher is constructed of cast steel throughout, with the exception of the large flywheels, and has a total weight of 450,000 pounds. The flywheels are 12 feet in diameter and weigh fifteen tons each. The swing-jaw shaft is 20 inches in diameter and weighs six tons, while the pitman shaft is 24 inches in diameter in the pitman and 20 inches in the bearings, and weighs 8½ tons. The swinging jaw of this machine is 13 feet in length by 7 feet wide, and weighs 74,000 pounds. The wearing plates are made entirely of manganese steel in sections which are interchangeable, so that the different sections may be changed about from time to time, thereby greatly increasing their life.

All bearings are water-cooled, and compression grease cups 12 inches in diameter are provided as an integral part of such bearings for lubrication.

The over-all length of the crusher is 24 feet, the width 15 feet, and the height 13 feet. A better idea of the construction of this machine may be obtained by referring to a sectional view, Fig. 1.

Second Crusher.—The second crusher has an opening of 3x6 feet and is of the same type as the large one, with an over-all length of 13 feet, width 13 feet, and height 9 feet. The swing-jaw shaft is 12 inches in diameter, and the pitman shaft 14 inches in the pitman and 12 inches in the bearings. The flywheels are 8 feet in diameter by 12-inch face, and have a peripheral speed of 5,000 feet per minute, being operated at a speed of 200 revolutions per minute. The total weight of this machine is 210,000 pounds.

Elevator.—The location of the plant is such that it requires the raising of all product, after passing the second crusher, to the screen. The elevator used is of the continuous type, each bucket being 42 inches long, 18 inches deep and 19 inches projection. These buckets are fastened to a shaft, the ends of which are equipped with steel-bushed rollers. These rollers travel on a 30-pound rail made fast to runway timbers. Each bucket is provided with a double link bar on each side, made of ½x3x18-inch bars. The rollers are lubricated by means of compression grease cups suitably connected to the end of the roller shaft. The buckets are made of ¼-inch steel pressed from a single sheet and reinforced with a ¾x2-inch bar-strap fastened on the lip of the bucket, for taking the wear at this point. The speed of the elevator is 95 feet per minute. The head of the elevator is equipped with compound back gears of large dimensions and operated from the line shaft that drives the screen.

Chutes.—All chutes in the plant are lined with sheet steel.

Rolls.—The 60x30-inch heavy-duty roll (Fig. 3) is one of the largest smooth-faced rolls yet built in this country, considering the width of face and weight of machine. This roll has an overall dimension of 16 feet. The shafts are 16 inches in the hub and 14 inches in the bearings, each bearing having a length of 46 inches. The frame is cast in one piece, and alone weighs 30 tons. The drive pulleys are made of cast steel, the main pulley being 96 inches in diameter by 24-inch face, while the smaller pulley on the movable roll is 60 inches in diameter by 14-inch face. This roll is operated at a speed of 50 revolutions per minute, or a peripheral speed of 785 feet per minute.

The rolls are equipped with an ingenious lateral adjusting device that prevents corrugating or channeling of the roll tires. The bearing of this roll is so constructed that it is double the size required for the work being done, is positively dust proof and efficiently lubricated. Its capacity is 300 cubic yards per hour, crushing from 4 inches down to 2 inches.

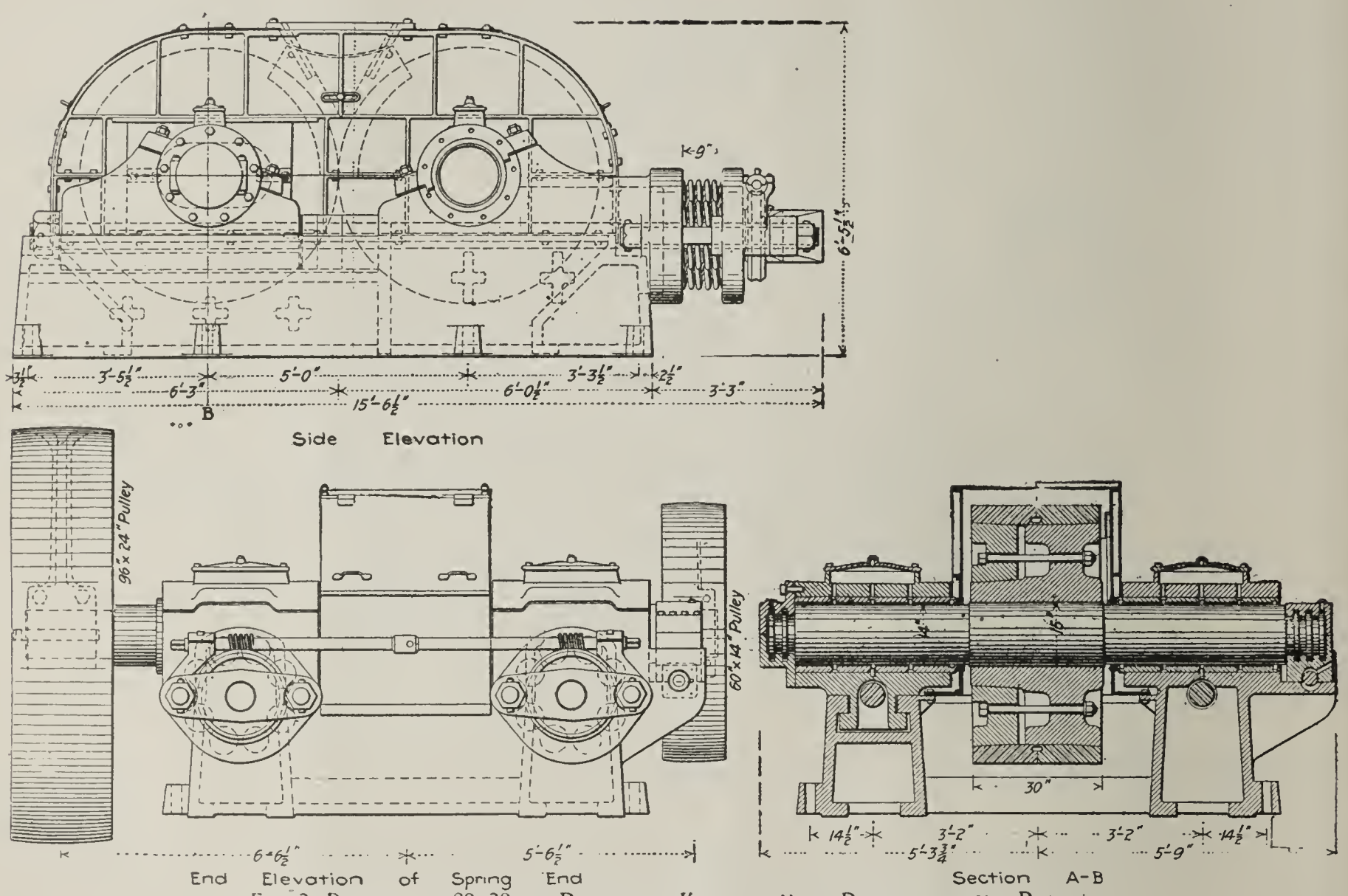


FIG. 3. DETAILS OF 60x30-IN. ROLLS FOR KENSICO DAM ROCK-CRUSHING PLANT

Power.—The large crusher is operated by a 300-horsepower, 3-bearing, form "M" mill-type induction motor, of the slip-ring type, and has about 2½ times full-torque load in starting. It operates at a speed of 560 revolutions per minute. This motor is equipped with a self-starting regulator, 33x27-inch pulley, and drives a jack shaft with a 26-inch triple leather endless belt, the pulley on this shaft being 94x27 inches. This jack shaft is equipped with an approved individual friction cut-off clutch which permits the starting of the crusher after the motor is in motion. On this jack shaft is a 60-inch heavy sheave wheel, with 15 grooves for 1½-inch rope, by which the large crusher is operated, the driving sheave on the crusher shaft being 11 feet in diameter. A suitable tension carriage and idlersheave is installed in connection with this rope drive.

It will be noted that on account of the intermittent load, due to the irregularity in the size of product fed into a crusher of this size, it becomes necessary to have great flexibility in the transmission, although it is apparent that when this crusher is operating at full speed, with the enormous momentum of the two 12-foot 15-ton flywheels revolving at a peripheral speed of 3,400 feet per minute, there can be but little variation.

The motor for operating the 3x6-foot crusher is 150 horsepower, 560 revolutions per minute, and of the same type as the 300 horsepower motor above mentioned. It is equipped with self starting regulator, and a pulley 29x21 inches is belted direct to the crusher, with a 20-inch extra double leather, endless belt.

The crushing roll is operated by a 100-horsepower, 560 revolutions per minute motor, of the same type as the others, and is equipped with a pulley 21x17 inches, which drives a 108x17-inch pulley on a jack shaft, this jack shaft operating the rolls and also the countershaft that drives the roll feeder.

The elevator and screen are driven by a separate 50-horsepower type "K" squirrel-cage induction motor, equipped with self-starting regulator, and operates at a speed of 850 revolutions per minute.

There are two conveyors in the plant—one, the short or cross conveyor, is operated by an individual 5-horsepower type "K" motor, direct connected through gearing and countershaft; the other, or main conveyor, is driven by a 15-horsepower type "K" motor, direct connected through gearing and operating at a speed of 850 revolutions per minute, and provided with an automatic starter.

The entire plant will be electrically operated by power transmitted from New York City, with current of the A. C. form, 3-phase, 60-cycle, 440 volts, stepped down from 2,200 volts.

Personnel.

The work is being done under the supervision of the Board of Water Supply, City of New York, with J. Waldo Smith, chief engineer.

The contractor, as noted above, is H. S. Kerbaugh, Inc., of New York and Philadelphia, with Beverly R. Value as chief engineer, B. C. Collier, resident engineer, and G. H. Angell, superintendent.

The crushing plant was designed by the Traylor Engineering & Manufacturing Co., 30 Church St., New York, and is being installed in its entirety by them, including all buildings and the setting of the machinery.

CONCRETE CISTERNS.

The Patent Concrete Cistern Company was recently incorporated at Grand Forks, N. D., with a capital stock of $25,000.

AN EFFICIENT METHOD OF HANDLING CONCRETE FOR STREET PAVING BASES.

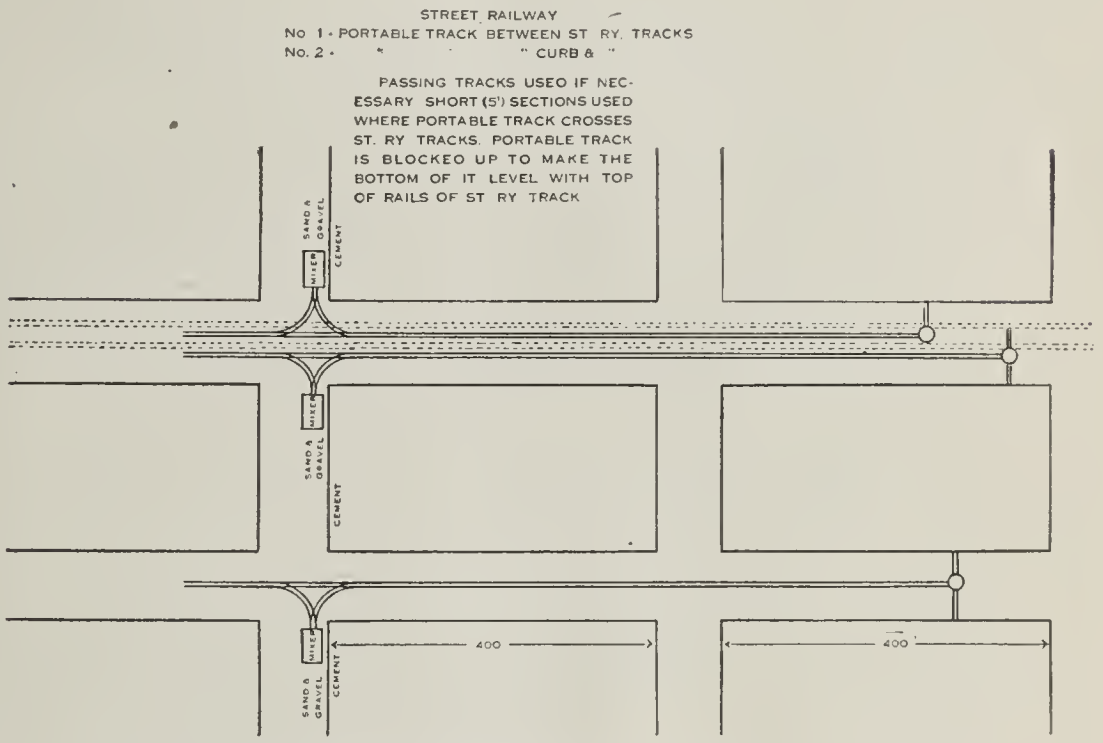
The illustration shows the plan view of an installation used in laying the concrete street bases in Portland, Ore.

This installation embodied several novel features, and resulted in a great saving in both time and money over the ordinary methods of handling concrete in this kind of work.

The raw material was piled on a cross street back of the mixer, and a drag bucket was used to haul the sand, gravel and cement to the mixer.

On the streets where there were no railway tracks, Koppel portable track was laid down the center of the street, a Y switch leading to the mixer, as shown in the drawing. A turn-table was placed at the end of the track, and from the turn-table, short sections of portable track was laid at right angles, to the length of the street, and reached to the curb line.

The mixer unloaded directly into Koppel steel dump cars, and the cars were then run down the track to the right or left, and the concrete deposited just where it was needed, requiring very little shoveling. In this way a section of the street base was laid clear across the street, after which the turn-table and cross tracks were moved six or seven feet back toward the mixer, by merely removing a section of the portable track.



Portable Track Arrangement on Portland Job — Elwood Wiles, Municipal Contractor.

On the streets where there were double railway tracks, two different methods were employed in carrying on the work. In both of these methods, the mixer, materials and Y switch were placed as in the method just described.

On some of the streets the portable track was laid the length of the street between the two railway tracks. This method allowed the concrete to be dumped to either side of the portable track, thus filling in the space between the railway tracks. At the end of the portable track, a turn-table was placed, from which a section of portable track ran to one curb. This left one of the railway tracks clear, while on the other, when a car came along, the cross section of portable track was very easily lifted up and replaced after the car had passed. The turn-table and portable track were blocked up just enough to permit the cross track to be laid on top of the street railway rails, so no elevated tracks were required. After the one side of the street, and the section between the railway tracks, was completed, the portable track was moved to the other

side of the street and that part of the street completed. Another method employed on streets with double railway tracks, was to lay the portable track on one side of the street, and fill in that side of the street and one of the railway tracks. The portable track was then moved to the other side of the street, and that side and the other railway track filled in. This left a space between the two railway tracks to be filled in which was done by using the turn-table and a cross section of portable track which was laying either side of the street.

In all three methods employed, the concrete was dumped away from portable track and as a section of the base was laid, a short section of the portable track was removed and the turn-table and cross section of track moved back toward the mixer.

The great advantage of all three methods was that the concrete was placed just where it was needed, and handling the concrete reduced to a minimum.

Mr. Wiles, of Portland, Ore., the contractor in charge of the work states that he saves so much by this method of handling his concrete, that he will use it on all future jobs. His experience should be of value to other contractors, especially since such equipment can be rented from the manufacturers, The Orenstein Arthur Koppel Company, of Pittsburgh, Pa., if it does not pay to purchase outright.

PROPOSED STANDARD SPECIFICATIONS FOR CONCRETE STONE, BLOCK AND BRICK.*

Concrete architectural stone, building block and brick must be subjected to compression and absorption tests. The test samples must represent the ordinary commercial product of the regular size and shape used in construction.

Compression Test—(a) In the case of solid concrete stone, block and brick the ultimate compressive strength at 28 days must average 1,500 lbs. per sq. in. of gross cross-sectional area of the stone as used in the wall, and must not fall below 1,050 lbs. per sq. in. in any case.

(b) The ultimate compressive strength of hollow and two-piece building block at 28 days must average 1,000 lbs. per sq. in. of gross cross-sectional area of the block as used in the wall, and must not fall below 700 lbs. per sq. in. in any case.

(c) In the case of hollow building block the gross cross-sectional area shall be considered as the actual wall area including the block and air space displaced by the block.

(d) In the case of two-piece block the block shall be tested in pairs consisting of the front and rear block as used in the wall. The compressive strength shall be regarded as the sum total sustained by the two block divided by the product of the length of the block and the width of the wall.

Absorption Test—The percentage of absorption at 28 days (being the weight of the water absorbed, divided by the weight of the dry sample) must not exceed 5 per cent when tested, as hereinafter specified.

Standard Methods of Testing.

General. (a) Laboratory—All tests required for approval shall be made in some laboratory of recognized standing.

(b) Samples—For the purpose of the tests at least nine samples or test pieces must be provided. Such samples must represent the ordinary commercial product, and shall be selected from stock. In cases where the material is made and used in special shapes or forms too large for testing in the ordinary machines, smaller size specimens shall be used as may be directed.

(c) Tests—Tests shall be made in series of at least three. The remaining samples are kept in reserve in case duplicate or confirmatory tests be required. All samples must be marked for identification and comparison.

Compression Tests—The compression tests shall be made as follows:

(a) Solid Concrete Stone, Block and Brick—When testing solid concrete stone, block and brick, the net area shall be considered as the minimum area in compression.

(b) Hollow and Two-Piece Building Block—Whenever possible such tests shall be made on full size block. Whenever such tests must be made on portions of block, both pieces of the block must be tested and both must contain at least one full web section. The samples must be carefully measured, then bedded flatwise in plaster of Paris to secure uniform bearing in the testing machine and crushed.

The net area shall be regarded as the smallest bearing area of the piece being tested. The total compressive strength shall be divided by the net area to obtain the compressive strength in pounds per square inch of net area of each piece. The sum of the two results shall then be averaged to obtain the average strength in pounds per square inch of the net area of the total block.

The entire block shall be carefully measured to determine the maximum air space prior to breaking the block for the compression tests, and the net compressive strength obtained shall then be reduced to compressive strength in pounds per square inch of gross area, this being figured from the actual air space of the block determined above.

Absorption Tests—The sample is first thoroughly dried to a constant weight at not to exceed 212° F. and the weight carefully recorded. When dried, the sample is to be immersed in a pan or tray of water to a depth of 2 in. resting on two strips not over 1 in. in width to allow the water to have free access to face. At the end of 48 hours from the time it is placed in water, the sample shall be removed, the surface water wiped off, and the sample carefully weighed.

*Presented at the eighth annual convention of the National Association of Cement Users, Kansas City, Mo., March, 1912; to be voted upon by members in letter ballot.

SANTA CRUZ PORTLAND CEMENT COMPANY TO MAKE PURE WHITE CEMENT.

Another new industry has been added to the Santa Cruz Portland Cement Company, and another natural resource has been developed in the vicinity of Santa Cruz. White cement, used in finishing the outside and inside of buildings, giving a marble effect, is the new discovery over which the local cement company is elated. The information is given us by Superintendent F. H. Davis of the Santa Cruz Portland Cement Company, Davenport, Cal. White cement now sells in the San Francisco market at $7 a barrel, where ordinary cement sells at a price ranging from but $2 to $2.50 a barrel.

Mr. Davis says that his company has been carrying on experiments for some time past, and with most gratifying results, for the manufacture of white finishing cement has now passed the experimental stage with them, and their output is equal to the best eastern product.

In two weeks the Santa Cruz Portland Cement Company will begin manufacturing this new product for the market in real earnest, and they expect to manufacture 20,000 barrels the first month.—Santa Cruz Sentinel.

NEW PLANT WOODVILLE LIME AND CEMENT CO.

The new plant of the Woodville Lime and Cement Company, whose offices are located at Toledo, Ohio, is very nearly completed and by May 1st the wheels will be humming merrier than ever, and the plasterer will be again whistling his tune; for he can get his old favorite brand of hydrated lime—"White Enamel Finish."

On September 14th of last year the entire plant of the Woodville Lime and Cement Company, located at Woodville, Ohio, burned to the ground, and it was only after the most heroic and energetic efforts of the officers of the company that the wreck was cleared away and a new mill erected, which is the best equipped and most modern hydrated lime plant in the world.

The mill proper will be five stories high, flanked on either side by large lime sheds. At one side of the mill ployed in the erecting, even the various hoppers being of steel. Installed in this mill is a large Bonnot pulverizer, weighing over twenty tons and having a capacity of from thirty-five to forty tons per hour. Pouring through this mill, the hydrated lime is ground to unusual fineness, being blown by fans into a collecting bin. Four of the latest improved Urschel-Bates Valve Bagging Machines will be used for bagging purposes. The hydrated lime tumbles through these machines into paper or cloth bags which are automatically sealed.

In addition to the company's famous brands of hydrated and lump lime, this mill will turn out Enamel Alca lime—a hydraulic lime plaster. A complete line of builders' supplies will be carried in stock so that the host of customers can receive the benefit of carload freight rates by getting mixed carload shipments of hydrated lime, lump lime, Alca Lime plaster, gypsum plaster, Keene's cement, etc.

New Plant of Woodville Lime & Cement Co., Toledo, Ohio.

will be twenty patented kilns and parallel with these kilns will be twenty more, totaling forty kilns, and allowing a daily capacity of five hundred tons of hydrated lime to supply the ever-increasing demand for the product of this progressive company. On the other side of the mill will be a storehouse, eight hundred feet long, in which will be stored during the winter months a surplus of material to take care of the great spring rush. About fifty feet from the mill is situated the office and testing laboratories. Here is where every batch of hydrated lime is carefully tested by skilled chemists so that in no way can the merit of the product fall below the standard. The office is built of firepoofing block, over which, inside and outside, is plastered Enamel Alca lime.

This plant is constructed of steel throughout and designed by the most competent engineers of this country. Such a lesson was taught by the burning of the old plant that not one stick of wood has been em-

CONCRETE BRIDGES AND CULVERTS.

A new book on "Concrete Brdges and Culverts," has just been issued by that well known cement expert, H. Grattan Tyrrell. Leather bound, 4½x6¾ inches and contains 272 pages. It is a very interesting and useful book and will be sent postpaid on receipt of price, $3.00, by Cement & Engineering News, 1117 Schiller Bldg., Chicago.

DU PONT POWDER.

General T. Coleman du Pont, of Wilmington, Del., will give away his vast fortune accumulated in the powder business, except one million which he will keep. This money will be used in building good roads. One road now under construction will cost $2,000,000. He believes this method of disposing of his money is better than for hospitals and libraries.

THE STORY OF THE WHITE STRIP.

The development of any useful thing is seldom due to chance. The many public utilities which have become common through constant use represent in the main years of labor and experiment and often a constant struggle against discouraging and almost insurmountable obstacles.

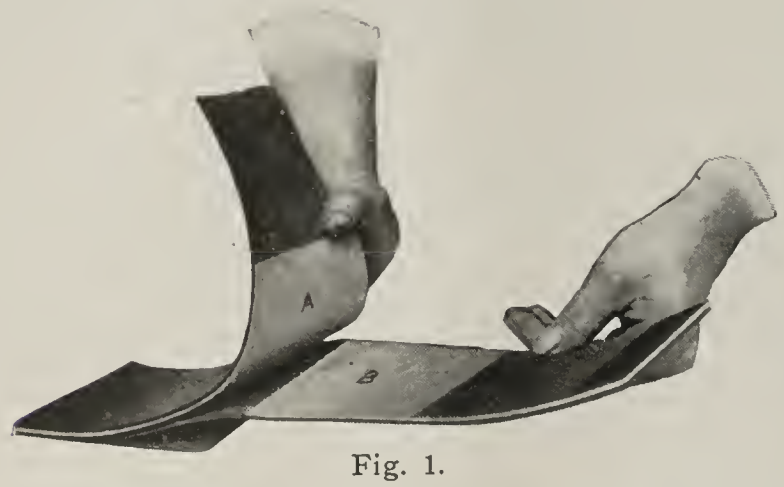


Fig. 1.

(Cut the lap the same as for a 3-ply belt as shown in the above cut. Scrape rawhide lap thin so as to be pliable; then cover the laps with two coats of Sea Lion cement, letting the first coat dry thoroughly before applying the second, then letting the second coat also stand until it is perfectly dry.)

A number of years ago a little group of men conceived the idea of developing a type of belting for power transmission that would be free from the faults of belting, which has been in use since this method of transmission was evolved. Experiments and tests were carried on in secret, and time after time success seemed almost in sight, but always some unforeseen defect undid the work and necessitated a new beginning.

Finally a belt was built that stood all laboratory tests, the arduous series of experiments seemed at an end, and the work of putting it on the market was undertaken and carried on for a time.

After belts were actually put in operation, it was found that while some would run with remarkable efficiency others would not be up to the prescribed standard. This was due to the cement, although the best procurable at that time was being used.

Here the matter rested, waiting until a satisfactory cement could be found. Three or four years ago tests were recommended, using "Sea Lion" cement, and after running several belts under severe conditions it was discovered that this cement was the long sought for link connecting probability to certainty.

During these years, the maker declares, belts have been run in places where ordinary leather belting would not last, and without a single known instance of failure.

Such is the story of the "White Strip Stretchless

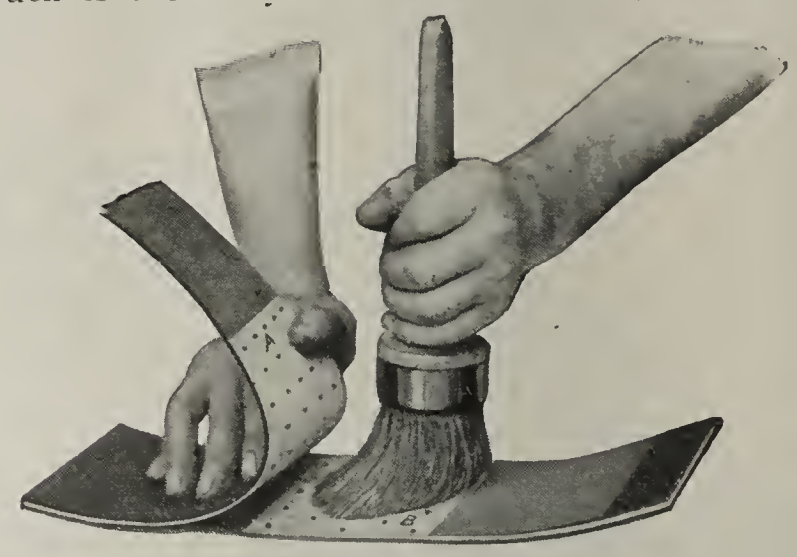


Fig. 2.

(Punch holes with small pegging awl in the rawhide lap as indicated above where rawhide is to be cemented to rawhide.)

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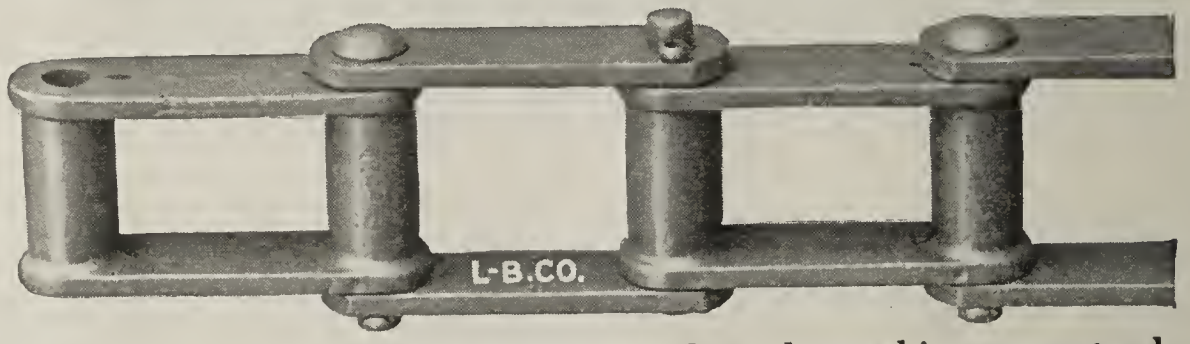

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Fig. 3.

(The final operation is indicated in the above cut. Use one coating of cement on one lap only, rubbing the brush to remove all surplus cement, as too much will soften the other two coats.)

Belt" made by the Chicago Belting Company, under its patents.

The principle of construction rests on the use of a strip of specially treated hard, dry rawhide between two outer plies of leather. Tests for tensile strength show that the breaking strain of this white strip of dry rawhide is from 15,000 to 19,000 pounds per square inch of area. In view of the fact that the breaking strain of 3/16-inch leather is about 4,000 to 6,000 pounds, the wonderful strength of the white strip is realized. Added to this strength are the two outer plies of leather, so that "White Strip Stretchless Belt," while of about the same thickness as double leather, has a greater tensile strength than 3-ply leather and yet the cost is only slightly above that of double belting.

This white strip of rawhide is prepared by a special patented process. It is non-stretchable, having only the necessary elasticity to make it a perfect transmission medium when inserted between two plies of leather. Being put together with "Sea Lion" cement, it is absolutely waterproof.

Making belts endless is not a difficult task for any experienced mill man, but the method of making White Strip Belts endless is more complicated. The accompanying cuts illustrate the methods used and by following the instructions carefully any competent belt man can put a "White Strip" belt on the pulleys endless without difficulty.

Figure I.—Cut the lap the same as for 3-ply belt as shown. Scrape rawhide lap so thin as to be pliable, then cover the laps with two coats of "Sea Lion" cement, letting the first coat dry thoroughly before applying the second, then letting the second coat also stand until it is perfectly dry.

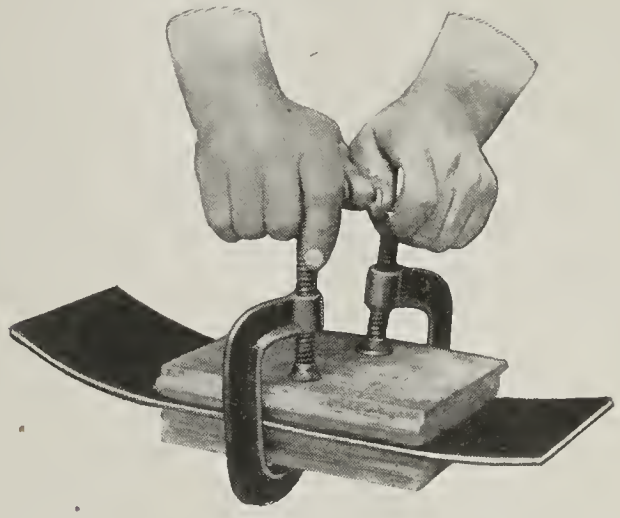

Fig. 4.

(Put the lap under pressure immediately, using blocks and thumb screws as shown above, but do not rub the lap.)

TURN-VEREIN BUILDING,

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Ceresit is a cream white paste which is dissolved readily in the water used in mixing concrete or cement mortar. By this method the Ceresit is uniformly distributed through the aggregates, thus filling the voids, and rendering it absolutely impervious to water or dampness even when subjected to great hydrostatic pressure.

Ceresit acts as a protector to concrete and cement—by keeping the materials dry it prevents disintegration by frost.

"Ceresit" Waterproofing

is Used in All Civilized Countries

Ceresit itself cannot crack or be chipped off, as it is an integral part of the mass. It therefore has a quality of permanence. Ceresit is economical in labor, requiring no extra mechanical apparatus or mixer. Ordinary workmen can mix Ceresit by the simple directions that always accompany the product.

Ceresit does not darken the concrete or cement, but it does give it strength. We guarantee Ceresit to be an efficient waterproofing for any job we undertake and direct, and to prove our faith we will put up a cash bond, if needed. All we ask is that you give Ceresit a fair trial. It will not disappoint the most exacting architect, engineer or contractor.

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Ceresit is Catalogued in Sweet's Index

Ceresit Waterproofing Company

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Corner Clark and Adams Streets CHICAGO

Figure 2.—Punch holes with small pegging awl in the rawhide lap as indicated where rawhide is to be cemented to rawhide.

Figure 3.—The final operation is indicated in Figure 3. Use one coating of cement on one lap only, rubbing the brush to remove all surplus cement, as too much will soften the other two coats.

Figure 4.—Put the lap under pressure immediately, using blocks and thumb screws as shown above, but do not rub the lap.

Do not run the belt until the cement is thoroughly set, which requires five or six hours, according to atmospheric conditions.

As a result of this method of splicing, the Chicago Belting Co. claims a belt is produced of unparalleled strength, non-stretchable and waterproof—three requisites for the highest transmission efficiency sought by experts for years.

CEMENT COMPANY WINS.

The California-Portland Cement Company won a victory, when Judge B. F. Bledsoe, in the Superior Court, declared that the dust-catching device used on the company's plant at Colton met the requirements of his injunction, granted a year ago, and upheld by the Supreme Court. This decision ended litigation between the cement company and orange growers that had lasted for several years.

"VEELOS" BALATA BELTING.

Mannheim Manufacturing & Belting Co., Mannheim, Pa., has erected a fireproof concrete building of the most modern construction, occupying floor space of about 30,000 square feet. The company is manufacturing the "Veelos" Balata belting, which has been for some years and is now manufactured in England by Turner Bros., Ltd. The machinery is all imported, and was built under the supervision of Turner Bros. The operating of the new plant is practically under the supervision of the English concern.

CONCRETE WORKS.

Winthrop C. Hall of Eugene, Ore., is erecting a concrete works. He is being assisted by C. W. Courtney, formerly of the Cement Products Company, Grants Pass, Ore. The building is in course of construction and the machinery will be installed as soon as the structure is completed. A large Besser sewer pipe machine will be installed, also brick tile and block machines of modern patterns. The plant will be modern in every particuar. Steam curing kilns will be used. The plant involves the expenditure of about $10,000 and will begin operations about March 15.

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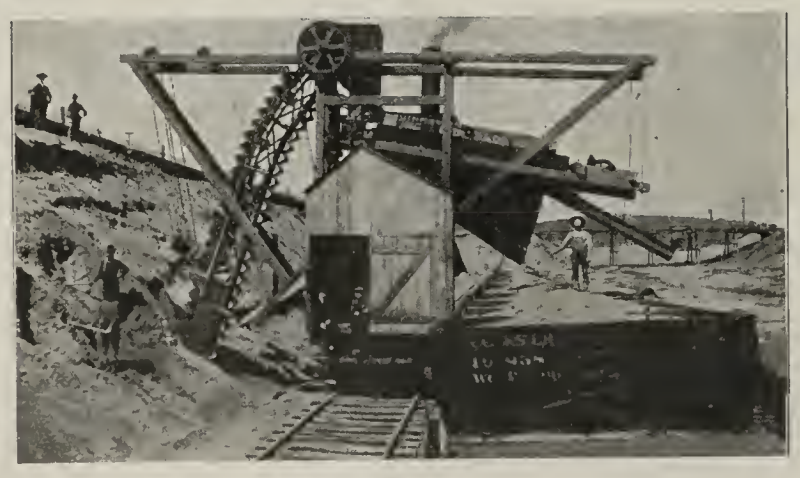

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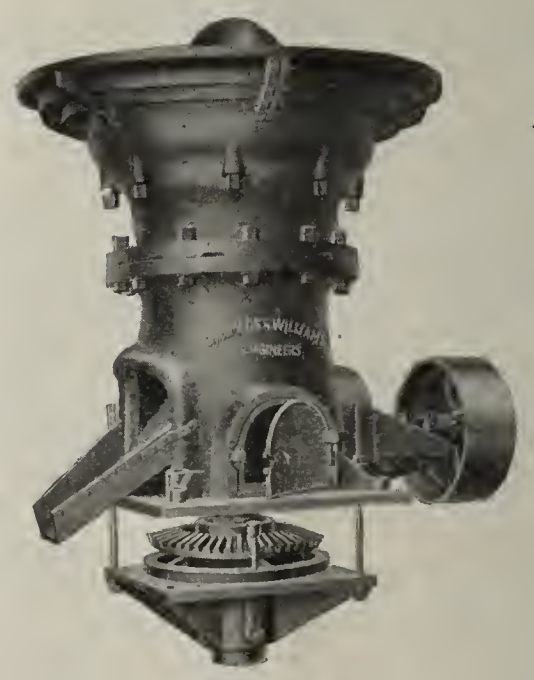

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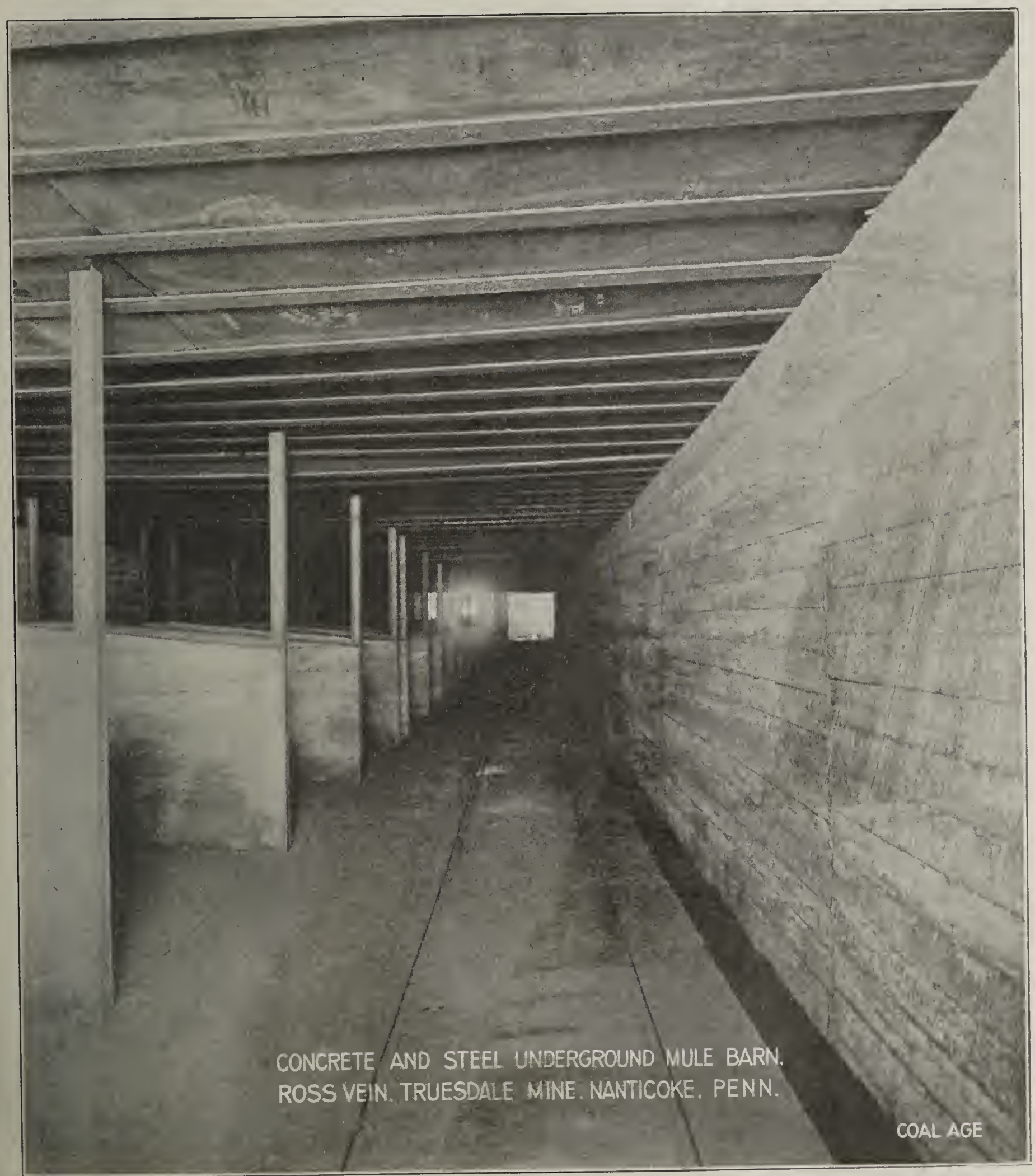

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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY

WILLIAM SEAFERT, Editor and Publisher

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JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, JUNE, 1912

PUZZUOLANA PORTLAND CEMENT.

The rapid strides which Japan has made during the past 50 years have astonished and aroused the admiration of the world. Every nation realizes that this country has entered the council of the first class powers for good and has to be reckoned with in the settlement of all political affairs of importance. Its splendid ability to defend its rights and to hold its own against formidable foes have procured for this formerly backward country the enviable position which it now enjoys.

However, not in warfare alone has Japan shown its mettle; with the same ardor it has entered all fields of scientific research and has likewise proven to be a great nation in this respect. Some of the greatest achievements of recent years in medicine, astronomy, agriculture and various other branches of science have been accomplished by Japanese savants. At the same time, all industries of Japan have grown wonderfully and have adopted the most up-to-date methods of manufacture.

The cement industry is one of the many instances in which the Japanese's keen power of observing and distinguishing between more or less satisfactory and economical machinery has led to a selection of the best he could find on the American and European markets.

Japanese cement manufacturers and cement experts have frequently toured the world, so that the names of the most prominent of them are familiar to most professional men of other countries. Their institutions for scientific cement research have been kept busy, in the same way as those of Europe and America, with observations concerning all questions of vital importance to the cement manufacturer and consumer.

The insular location of their empire, in which, more frequently than in most other countries, cement comes in contact with sea water induced the Japanese to pay special attention to problems involving the use of cement for marine construction. Elaborate researches along these lines were carried on for the past ten years by Dr. S. Kasai of Onoda, who recently summed up the results obtained by him in a comprehensive publication on Puzzuolana Portland Cement published by the Tonindustrie-Zeitung of Berlin, Germany, in which the advantages of the various ingredients of puzzuolanas were described and by which the statements of former observers were corroborated to the effect that especially the lean mortars used in actual construction work were greatly benefited by an admixture of puzzuolanas of proper composition.

WHITE PORTLAND CEMENT.

I note the editorial in your May issue on "Blanc White Portland Cement," and regret to learn that the Blanc Stainless Cement Co. has found it necessary to discontinue manufacturing. Mr. J. Maxwell Carrere, the manager of the Blanc company, has certainly done important pioneer work in demonstrating the value of white Portland cement in architectural and artistic uses, and has the respect of all who are acquainted with his personal qualities and ability. The editorial above mentioned contains, however, some statements quoted from Mr. Carrere which are calculated to give a false impression in regard to the relation of white cement manufacture to patents. The general process of making white Portland cement from materials practically free from iron is open to all, as I found to my regret in attempting to obtain a patent on this process fourteen years ago, in 1898. I applied March 3, 1905, for a patent on a certain method of manufacture which we found advantageous, and this patent was issued October 13, 1908. The only white cement patent to Mr. Carrere which has come to my notice is one, also on a special method, applied for May 10, 1907, and issued March 29, 1910. We have been manufacturing Medusa white Portland continuously since 1907, and are in no way following Mr. Carrere's process. Whether other manufacturers are infringing this or our patent we cannot state, but think it improbable that questions of patent infringement will arise in connection with the white cement industry. Respectfully yours, S. B. Newberry, Sandusky Portland Cement Company.

THE EWART FRICTION CLUTCH.

The Ewart Friction Clutch has been in successful use more than twenty years.

It is a type recognized everywhere as standard, and it is unquestionably the strongest and most efficient clutch of this type.

It is by far the safest clutch made. A pamphlet issued recently by The Link Belt Co. of Chicago will tell you why. A trial of the clutch itself will convince you.

Send for a copy of the publication.

UNITED STATES GYPSUM CO.

Directors of United States Gypsum, Chicago, Ill., authorized A. G. Becker & Co. to sell $1,500,000 five-year 6 per cent notes of the company. Notes to the amount of $400,000 are to be placed in the hands of a trustee to be used in exchange for the outstanding bonds of the company. Proceeds from the balance will be used to pay bank indebtedness as it matures, and supply the company with funds for the erection of new properties required to supply present business at much lower cost of manufacture, and the taking of new trade on a remunerative basis.

The Manufacture of Sand-Lime Brick in Europe

By P. L. Simpson, American Clay Machinery Co., Chicago, Ill.

(Paper read before the Sand-Lime Brick Manufacturers Association at their Convention at Grand Rapids, Mich.)

During my recent trip abroad, covering a period of four and one-half months, it was my privilege to obtain permission to visit some of the best sand-lime brick works in Europe. My first experience was in Great Britain, and arriving as I did in Glasgow, I lost no time in communicating with my friend, Mr. Robert Brand, Jr., of Perth, Scotland, whom I had met in this country about a year previous. Mr. Brand immediately gave me a very pressing invitation to visit him and inspect his works as requested.

The Silicated Brick and Stone Company, of Perth, Scotland, is owned by Mr. Brand, who is also a member of this association. That gentleman is entitled to a great deal of credit, because, notwithstanding many obstacles, he has now one of the best sand-lime brick plants in Europe. One can realize how many difficulties he has encountered when I state that he had to rebuild his plant twice over before obtaining satisfactory results.

The first outfit was designed by an English firm—which proved unsatisfactory, and a great bulk of it was rejected. Then Mr. Brand made a trip to Germany, where he bought another outfit, which also proved to be a failure, and a very small part of that outfit was retained. The press, for example, was discarded after a two weeks' run. Then, after all this experience, involving great expense and worry, he became his own engineer and his present outfit is the result.

The essential features of Mr. Brand's plant comprises:

1 The thorough pulverization of the caustic lime. No part of it is coarser than 100 mesh.

2. The batch system is used to measure the sand and lime. In other words, a definite quantity of sand is united to a definite quantity of lime.

3. An adequate and changeable amount of water is used when the batch of sand and lime is dumped into a batch mixer. When I say changeable, I mean that the quantity of water used is varied, according as the dampness of the sand varies. The sand is dredged from the River Tay, and naturally the dampness in same will vary according to the time taken for transportation to works, but a given quantity of water is always used with a given quantity of sand, which contains the same content of water.

4. After siloing the mixture, it is thoroughly prepared for the press by being put through two grinding and mixing pans. First the material is ground and mixed just as it comes from the silo, and after it leaves the first pan it receives another grinding, mixing and mulling, where it receives the necessary water. You can readily see from this bare outline of Mr. Brand's process, how thoroughly he prepares the material. His aim is to get plasticity, and of all the plants I visited in my travels, I did not find one that prepared the material as thoroughly as did Mr. Brand.

His object is, of course, to manufacture face brick, and for that reason it is quite necessary for him to adopt every known expedient to produce a first class article.

The quality of brick produced at Mr. Brand's works impressed me most favorably. A cracked or chipped brick is of rare occurrence.

The lime used is not first class, having, like most limes in Scotland, a content of magnesia, running from six per cent to ten per cent, but, notwithstanding this drawback, his brick are first class. From a test made by David Kirkaldy, of London, on the strength and porosity of Mr. Brand's brick, the following table gives the results:

Test No.	Description	Dimensions	Base Area	Cracked Slightly	Cracked Generally	Crushed
		inches	sq. in.			
		Sand-Lime Brick (No recess)				
2194	A3	2.82x9.03x4.40	39.73	268,800	282,400	282,400
		Sand-Lime Brick (Recessed one side)				
2192	A1	2.82x9.04x4.38	39.60	202,000	217,500	217,500
2193	A2	2.84x9.03x4.40	39.73	198,200	210,000	210,000
2197	B5	2.88x9.00x4.38	39.42	187,200	194,600	194,600
2196	B3	2.94x9.04x4.40	39.78	162,500	171,000	171,000
2195	B2	2.88x9.00x4.38	39.42	140,300	144,200	144,200
		Mean....	39.61	193,167	203,283	203,283
		Lbs. per square inch		4,877	5,132	5,132
		Tons per square foot		313.6	330.0	330.0

Made from River Tay sand and 8 per cent lime.
Bricks marked A made 12th April.
Bricks marked B made 26th April.

Test No.	Description	Before Immersion	After 24 hours Immersion	Difference	Absorption	
00		lbs.	lbs.	lbs.	per ct.	
2198	A4	7.746	8.422	.676	8.74	
2199	as above A5	7.826	8.445	.619	7.91	7.73
2200	B4	8.243	8.782	.539	6.54	

Summing up this table you will find that the bricks withstood an average of 5,132 pounds to the square inch, the average base area being 38.61, and the results as to porosity showed an average of 7.73 per cent. Calculation is based on a twenty-four-hours immersion. You will doubtless realize how excellent these results are. Mr. Brand's plant is the only one in Scotland now running. Another plant was established at Bathgate, promoters having a scheme of mixing asbestos with the sand. I saw several buildings built with artificial stone from this plant but they were crumbling away, which gives the sand-lime brick industry a setback in that part of the country. A friend of mine owned a large interest in this plant, but he stated to me it was a complete failure. There are but three plants that I know of in England, and two of the three are running. Two of them I visited. One near Liverpool, called the Hydraulic Brick and Stone Company. The plant is erected for the system known in this country as the Schwartz process. The sand that is used is a little like our Michigan City sand, namely, blown up by the sea into sand dunes, and has all the unfavorable conditions incident to a blown sand. This plant has been idle for a year and is for sale.

The other plant I visited was that of "Collier's Limited," at Reading, near London, but it was merely an incident to their clay works, which is quite extensive. At the time of my visit they were making a black brick, using bone black dust. They use the prehydrate system, slacking the lime in the cylinders below the cars. The business is not at all extensive, as they are unable to sell their product in London in competition with clay brick.

The sand-lime brick industry has not, as a general thing, proven successful in the British Isles. The reasons for this are that there are immense deposits of first-class clay in England, bricks being produced and sold at a very low price, and in Scotland the drawback is extensive; stone quarries are plentiful, and therefore stone of various kinds for building purposes is sold very cheap.

P. L. SIMPSON, CHICAGO, ILL.

Mr. Simpson was selected by the American Clay Machinery Co. of Bucyrus and Willoughby, Ohio, to investigate the status of the sand-lime brick and other industries in Europe.

Passing over to the continent, the first plant I visited was near Zurich, Switzerland, the owners of the works being Hunsicker & Co. They are about twenty miles from Zurich. Notwithstanding that I had a card of introduction to Mr. Hunsicker from an influential party, I was denied admittance to a large proportion of his works. He showed me only the lower floor of his factory. They have two double-mold rotary presses and one single rotary press, making 20,000 a day on each of the former and 10,000 on the latter. They have also seven hardening cylinders. The bricks made there were excellent in quality, which I ascribed to the nature of the sand. The sand bank is really a gravel deposit. They screen the stones out of the gravel for cement products, the sand being retained for sand-lime brick. The examination of his sand showed great variability of grain and also sharpness, and this favorable condition showed its effect on the product.

My investigation of the sand-lime brick industry in Europe did not really begin until I had arrived at Berlin, which is the real center of the sand-lime brick manufacture. I am pleased to state that I was quite successful in obtaining the proper introductions and entree to five different works in and around Berlin. These introductions were due largely to the courtesies of the "Ton-Industrie Zeitung." That newspaper is the leading organ for the sand-lime brick industry in Germany. It is a remarkable publication, having three issues per week, and their staff consists of a complete corps of editors, representing the various interests, the sand-lime brick department being in charge of Mr. B. Krieger, and I can fully attest to the uniform courtesy extended to me by that gentleman, and also Mr. Waidner, of the cement and lime department. That gentleman showed me through the establishment, which was well worth seeing. They have an immense laboratory with fourteen chemists at work testing all manner of material for the production of brick of all kinds and clay goods in general. There is no disposition of that newspaper to sidetrack or to minimize the importance of sand-lime brick manufacture. As a matter of fact, it would be exceedingly strange if they would not recognize an industry that has upwards of 350 different plants making sand-lime brick in Germany. It is of great importance, however, that a paper of the prominence and influence of the "Ton-Industrie Zeitung" should follow up every possible item in connection with the development and production of the sand-lime brick business.

Mr. Krieger gave me an introduction to a gentleman who is recognized as the foremost authority on the technic of sand-lime brick in Europe. That gentleman is Mr. George Beil. I was pleased to meet the gentleman in Berlin and to have a lengthy conversation with him, and I was quite impressed not only with the knowledge of the business that the gentleman has, but his uniform courtesy to a complete stranger to him, as I was, it being sufficient for him that I represented a member of this association and also, to some extent, the sand-lime brick industry in this country.

There is one part especially of my conversation with Mr. Beil that I desire mentioned here. You will notice that a table given by Mr. Robert Brand of Perth, Scotland, giving the crushing strength of his brick, states the base area of the samples. I can not recall a table showing the strength of brick before in my reading that gives the base area of the brick tested. It has been generally considered by manufacturers in America that the strength of the brick made in Germany was very much inferior to those made in this country. Mr. Beil, however, stated that the cause of this impression was due to the manner of testing our brick in America. We test the brick for crushing strength on its flat, using the surface of the whole brick, but this is not the method in Germany and France, and possibly other countries in Europe. In Germany they divide the brick in two and place one-half above the other, the joints all being made solid by plaster of paris or sulphur. By halving the brick, it makes a difference, according to Mr. Beil, of thirty per cent in the result. Thus, if the brick is tested as it is in this country, namely, with the entire area of the brick, and it would show a strength of 4,500 pounds to the square inch, by cutting it in two and testing it as they do in Germany, the strength apparently would be reduced about 1,350 pounds. Mr. Beil, therefore, desires to have this understood, especially by this association, that in comparing the strength of brick made in Germany with those made in this country, that the difference in the method of testing should be taken into consideration.

Mr. E. Leduc, author of the "Essais Sur le Silico Calcaire," pages 19 and 21, uses a round sample of sand-lime brick in arriving at crushing strength. His rule is to use the cylinder the height of which was exactly equal to the diameter, and Mr. Leduc goes to considerable trouble to obtain this condition. I was very glad to receive this explanation from Mr. Beil, so as to make it possible for me to use my influence in correcting this unfair and unjust comparison.

In Germany there is an institution known as the "Verein der Kalksandstenfabriken," which is a union of sand-lime brick manufacturers, and which maintains a regular office in Berlin for the purpose of promoting the industry in Germany. The essential requirements for admittance to that union is to produce brick having certain strength and quality. That strength is 140 kg. per sq. cm., which is equivalent to nearly 2,000 pounds to the square inch.

Mr. H. Buchartz of the department for the examination of building material at the Royal bureau for testing material, at Gross-Lichterfelde-West, makes the following statement in his book on sand-lime brick, published in 1903: "Experience has proven that with a practical equipment and proper method, no difficulties arise to manufacture sand-lime brick with a strength of 140 kg. per sq. cm. Therefore, the association of sand-lime brick manufacturers put its members under obligations (in 1903) to manufacture sand-lime brick having a minimum crushing strength of at least 140 kg. per sq. cm. Many factories, however, factories even in Berlin that are not eligible for admission into the union, for the reason that they are not complying with the requirements of the association in regard to the strength of their brick. In all fairness, however, and after a thorough examination of at least one of these outside concerns, I found that the fault was not due to their process or their machinery, but to their sand. In fact, one of the best plants I visited in Germany was outside of the association and produced a brick that was not up to the standard in strength, but they simply had been unfortunate in selecting a location close to market of course, but with a sand that was very inferior, and, therefore, an inferior production was the result.

Touching on the question of lime, fortunately for Berlin there are immense deposits of limestone at Kalberge, near Ruddersdorf, which is about thirty miles from the city and accessible by water. It is a lime somewhat hydraulic in its nature, having a considerable percentage of silica in its composition, but quite free from magnesia.

General view of Berliner—Kalksandsteinwerke—Robert Guthman, near Berlin, Germany, Capacity 440,000 sand-lime brick per day.

produce sand-lime brick with a crushing strength up to 300 kg. per sq. cm., and even more."

The Sand-Lime Brick Association also uses for its own protection a trade mark which is an equilateral triangle with the words K. S. V. printed therein in large letters. These letters indicate the initials of the name of their association, namely, the "Vereins der Kalksandsteinfabriken," and this trade mark is printed on the envelopes and letter heads of the association, and is sometimes stamped on the bricks. The members of the association are, therefore, under obligation to produce sand-lime brick with this minimum crushing strength, and should a manufacturer fail to fulfill this requirement, he forfeits the right to use the trade mark until evidence has been furnished to show that the standard has again been reached. The annual dues paid by each member is based upon the quantity produced. From one to ten millions production, the dues are twenty marks per million; from eleven to twenty millions, twelve marks per million; from twenty-one to thirty-five millions, six marks per million; the maximum is 410 marks per year. The various committees appointed by the association are:

1. Committee on new processes, machines, etc.
2. Committee on rules and regulations.
3. Committee on publications.

The association has been one of great influence in the development and improvement of the sand-lime brick industry, not only in Germany but all over Europe. Its active membership, each one representing a sand-lime brick factory, consisted in June, 1910, of seventy-eight members. There are sand-lime brick

This lime is burnt in continuous kilns of the Hoffman type. Very large works have been erected at Kalkberge and one prominent brick works in the neighborhood of Berlin burns its own lime. I refer to the Berliner Kalksandsteinwerke—Robert Guthmann. They have a twenty-six chamber continuous kiln, Hoffman type, burning 100,000 kg. of lime per day, which is equal to about 110 tons.

Through the courtesy of the secretary of the Union of Sand-Lime Brick Manufacturers, I was enabled to obtain the entree to three of the five sand-lime brick works that I visited in and around Berlin. These three establishments represented three different processes. The first works I visited was erected about eight years ago. The sand was of good quality and the lime was obtained from the neighboring limestone deposits at Kalkberge. The characteristic of this establishment was mainly the method of treating the lime, which is known in Germany as the "Loesch-trommel," or slaking-drum process, and which consisted in this particular case in slaking all of the lime and one-third of the sand in a slaking drum. This makes an excellent basis for the remainder of the sand to be mixed later in a wet pan. These works have two double-mold rotary presses, each making 32 bricks per minute, or an average of 18,000 per day, each running ten hours per day. Caustic lime was pulverized to about 60 to 80 mesh, which was not as fine as the superintendent would have desired. My impression of the plant was excellent, although in some respects it was not ideal, because there was some guess work in the process, inasmuch as the uniting of the remaining portion of raw

sand with the drum mixture was done by two men shoveling both the drum mixture and the raw sand into an elevator to be elevated to the wet pan. Notwithstanding this drawback, however, the plant was well managed. Everything was in fine order, and with this defect corrected, which was acknowledged by the superintendent as being a defect, the plant would certainly be an excellent one. The slaking drum idea appealed to me as being correct in principle, free from dust, systematic and in many respects an improvement over some of the other plants that I subsequently visited.

The next establishment that I visited in the same neighborhood was based upon the purely silo process. In this case the raw sand and pulverized lime was automatically measured, although the means of performing the measuring of the sand and lime did not appeal to me as being first class, same means having been in use in some works in this country which afterwards proved a failure. They seem, however, to stick to the idea. Aside from this the works were well built and especially the silos appealed to me as being most substantial. Wooden silos seem to be a thing of the past in modern plants in Germany, and the silo I saw at the works under review was constructed of steel, supported on substantial cast iron posts and emptied automatically and regularly. They had upright presses in this plant, using three men for off-bearers. One man was busy putting in a sheet steel pallet, and the other two men taking the brick off the pallet, as delivered by the pallet handler. This seemed to me one man too many at each press. They have five hardening cylinders and keep their brick in the cylinder for twelve hours, at a pressure of eight and one-half atmospheres. Please note the twelve hours in the cylinder, as it would seem to me to be the tendency in Germany to increase the time for bricks to remain in the hardening cylinder, and also to increase the pressure.

The next plant I visited was again indifferent. In this case they had the "Loesch-trommel," or slaking drum, but the lime only was slaked without any sand being added. This process did not appeal to me as being an ideal system. The contents of the slaking drum were dumped into a bin below, and which caused a terrible dust all over the works. In fact, it was the dustiest works I visited. Quite a quantity of the lime blew out of the slaking drum when the pressure of steam rose up to the point where it was necessary to relieve the pressure. A pipe led from the slaking drum to a separate room some distance away, where an attempt was made to collect the lime blown from the slaking durm into that room, but the outfit and its operation appealed to me to be quite awkward and anything but ideal. Then again, another bad feature of the works was the amount of guess work used in adding the amount of lime to the sand. A large proportion of the sand was gravelly. The stones were taken out by a revolving screen, and was conveyed on a shaking conveyor to an elevator, and while being conveyed a man shoveled the lime onto the sand according as, in his judgment, would be necessary. This was the most unique specimen of guess work I ever saw in any sand-lime brick factory, and I was surprised that such a method was used in a representative plant. Notwithstanding these drawbacks, which were very conspicuous, the plant made fairly good brick and was evidently a money maker, as the production was about twenty-five millions per year. The sand, however, was excellent, which no doubt had a corresponding effect on the quality.

The next plant I visited was, in my opinion, an improvement, in some respects, to any of the others that I had examined. In this case all of the sand went through the slaking drum. One-half of the sand was used with all the lime, and after the lime was slaked in the slaking drum, the remaining portion of the sand was added. This plant, however, was handicapped by poor material, and the poor brick resulting from their poor sand excluded them from the union. At all events, this was the reason I received for their not being in the union. The material, after passing through the slaking drum, is siloed for a short time, but in this case the silo or bin was a wooden one, which was not exactly in accordance with the best practices.

Receiving Depot at Berlin of the Berliner—Kalksandsteinwerke —Robert Guthman

Now, it was my privilege and great good fortune to obtain permission to visit the largest and best known sand-lime brick works in the world, namely, that of the Berliner-Kalksandsteinwerke, Robert Cuthmann. There works are at Neiderlehme. They have twenty upright presses, each making two brick at each pressure, but only two men in this case were used as offbearers for each machine. I was taken around the plant by Mr. Mohnike, the works manager. The locomotive brings ten dump cars, each containing about two cubic yards of sand, from the sand deposit —the cars being of the bottom-dump type—and in less than five minutes they are emptied into the cellar below the track, to be shoveled into the elevators leading up to the mixers. The lime is pulverized to the requisite fineness and united with the sand, both being automatically measured. This plant has adopted the silo process. There are eight silos in the plant built of steel in a most substantial manner, each con-

taining enough material for 80,000 German size bricks. The siloed material received its proper quantity of water in the wet mixer and emptied in buckets, which run on an overhead track, and are emptied into the different bins located above each press.

There are two cylinder rooms, one containing eleven, and the other nine hardening cylinders, the size of same being 20 metres (about 65′-6″) long, by 1 M 80 (about 70¼″) in diameter, each cylinder containing 13 hardening cars, and having a capacity of 9,000 brick, German size, which is 250 MM long by 120 MM wide by 65 MM thick, or 9⅞x4 3-16″x2 11-16″.

Unloading Sand-Lime Brick from the Barges at Charlottenberg

A very interesting feature of the works are the two very large transfer rooms, each of them over 80 feet wide and containing a transfer car about 75 feet long. These transfer cars hold all the contents of a cylinder, and also the locomotive that hauls them, either out of the cylinder in the case of the hardened brick, or into the cylinder in the case of green brick. When the bricks are hauled out of the cylinder by the loco-

HOME OF MR. MOHNIKE
Superintendent of the Berliner Kalksandsteinwerke

motive, they are run down to the wharf. The bricks are at this point unloaded and sorted from the hardening cars and packed into barges, each containing about 100,000 brick. These boats are then towed to the receiving and shipping station at Charlottenburg, Berlin. In the event that there are no barges on hand into which to load the bricks, they are stored on the yard, to be eventually shipped when necessary. When the barges reach Charlottenburg, the bricks are then unloaded into truck or wagon frames. These are made of steel and arranged so as to be hoisted by electric cranes. Each frame contains about 1,100 brick, which is the established unit. There are about six of these cranes that can be applied when necessary. They all overhang the river and an empty frame may be attached to each one of them, same being lowered down into and loaded from the barge, then hoisted up and run over to the point to be lowered onto the wagon bed and then to be hauled to the building. These six cranes cover about the length of the barge, and, therefore, the unloading of the boat is accomplished in a very short time.

While in some respects, especially at the unloading

WATER TOWER AT BERLINER KALKSANDSTEINWERKE
Robert Guthman, at Niederlehne, near Berlin
Built of Sand Lime Brick, 160 Feet High, 37 Feet Diameter

and receiving depot at Charlottenberg, this method of handling is ideal—I refer especially to the loading of a unit of brick onto portable steel truck frames—yet it is in the loading of the barge at Niederhelme and the unloading of the same into frames at Berlin where a great saving of labor could be effected.

At the docks at Niederhelme, the bricks as they are sorted are run down a runway to the hold of the barge, where they are caught by the loaders and packed. Then again, where the barge reaches its destination, manual labor is again necessary to load the bricks from the barge onto the steel truck frames; also when it is required to store the bricks on the yard, which frequently happens, another double loading is required, making in that case four separate handlings of the brick. Further, when it is required to store the brick at the receiving depot at Charlottenburg, a further double loading is necessary, so that when this extreme case happens, the same brick are handled by hand six different times. This would seem not only to be a waste of labor, but every time a sand-lime brick is handled, or any other brick for that matter,

they are apt to be chipped and many poor brick produced, that otherwise would not be the case.

Now, if such a method as the Penfield brick-handling system were adopted, the labor of handling the brick would be reduced at least one-half to two-thirds. Just imagine what a saving would be affected by such a system, especially in a yard where there are 440,000 brick manufactured daily, as is the case in the works under review.

It may be interesting to detail to you as briefly as possible how such a great saving can be effected, and which will at the same time give you an insight into the merits of the Penfield brick handling system. First of all, the bricks could be sorted off the hardening cars at the wharf and packed into the necessary units, which in this instance is 1,100 bricks, these units having the proper length, width and height as may be required to fit the steel truck frames at the receiving and loading depot in Berlin. The Penfield brick handler would then lift each unit by an electric crane, which, of course, would have to be erected at the wharf, these cranes to be designed with projections overhanging the scows on each side of the pier. These units would be lifted by a brick handler and lowered down into the hold of the scows; when the latter reaches the receiving depot they would be in exactly the same condition as they were when loaded, and would then be lifted out of the barge by the electric cranes and lowered either on to the bed of the wagon to be hauled to the building, or placed into the storage room at the depot. The unit, you will notice, remains intact from the time the bricks are sorted at the wharf at Neiderhelme, until delivered at the building in Berlin. Further, when storage is necessary on the yard, the unit is still preserved after the bricks are sorted and may be piled on the storage ground by cranes, and it would not be necessary to cover so much ground as is now the case, because they could be piled as high as a crane would permit. One can at once realize how great a saving can be effected in handling brick in this way.

Now, to sum up my impressions of the sand-lime brick industry in Europe and especially around its chief center of Berlin, Germany:

First—From personal observation and from all information that I could gather from experts in the business, I concluded that the pre-hydrate system was gradually being eliminated from up-to-date practice. There are no new works installing the process and the works that are still using it are gradually abandoning it. I interviewed Mr. Beil at his office in Berlin in this way: Which is your preference in regard to the following five different methods of making sand-lime brick:

"A"—Hydrating the lime in slaking tubs under brick cars in cylinder.

"B"—Hydrating the lime in a slaking drum without sand.

"C"—Hydrating all of the lime with part of the sand in a slaking drum, afterwards adding the remainder of the sand outside of the drum.

"D"—Hydrating all of the lime with part of the sand in a slaking durm, afterwards adding the remainder of the sand inside of the drum before latter is emptied.

"E"—Hydrating the lime with all of the sand in silos.

Mr. Beil, without hesitation, stated that the two latter methods were the only proper and correct systems to install.

The attitude of the experts I talked to in regard to the method of slaking the lime in hydratic boxes underneath the brick cars in the hardening cylinders, was that it was unreliable, wasteful and entirely out of date.

Second—All of the latest works erected in Germany, as far as I was able to find out, were recognizing the principle of the thorough mulling and kneading of the sand and lime mixture by using wet pans where the mixture receives the final water, and all of the grinding incidental to the system.

In all the works in Germany that I visited, no face brick were made. All of the production is common brick, but a hard, solid body is requisite and always aimed at and, therefore, the use of the wet pan to attain this object is thoroughly appreciated in Europe as well as in this country. I was much pleased to note that the necessity for using a wet pan in the proper preparation of the material, which is in accordance with the latest ideas in this country, is also recognized abroad as well as here.

Third—I was also much impressed by the fine management of the different works I visited. I can account for this by the further impression I received that the industry is in the hands of high grade men, those

HOLLISTER LUMBER CO'S NEW BUILDING.
Goodman Street, Rochester, N. Y.

500,000 Sand-Hime Bricks Used, Manufactured by Rochester Composite Brick Co., Rochester, N. Y.

having charge of works and experts in general with whom I came in contact and had the good fortune to meet, were unusually able and finely educated, and the courtesies shown to a stranger like myself showed that they were gentlemen both by nature and by training.

I was glad to meet such men as Messrs. Beil, Kreiger, Waidner, Bockhous, Mohnike, Michel, Brand, etc., and I may say here that these men are among the leaders in Europe, having the present and future interest of the sand-lime brick industry in charge.

I purposely stopped off at Paris on my way from Berlin to Paris to interview Mr. E. Leduc, author of the work, "Essais, Sur le Silico Calcaire," but I was unfortunate in not seeing him, as he had left Paris to take charge of a Portland cement factory at a point somewhere near Nice, in the south of France. I mention this because there is great respect shown the name of Leduc in Germany, so much so that Mr. Krieger, of the "Ton-Industrie Zeitung" has translated his work on sand-lime brick into the German language. No one in Europe has gone into the subject with greater care theoretically than Mr. Leduc. I visited the "Conservatoire National des arts et Metiers" where he did his experimenting work, and was introduced to his successor, whom I was glad to meet and he stated

that he expected to follow up the valuable work of his predecessor.

Fourth—I was also impressed with the great care shown by the owners of the various sand-lime brick works in looking to the comfort of their men, in providing proper dwelling houses and pleasant surroundings. This was best illustrated perhaps at Niederhelme, where the workmen have pleasant homes to live in. Mr. Mohnike, the works manager, has a beautiful home of very fine architecture, which you can see by the photograph attached to this paper. The water tower of the Robert Guthmann works is one of the most artistic of any I saw in Europe. It is modeled after a celebrated tower in Constantinople and is about 160 feet high by about 35 feet in diameter, and is built of sand-lime brick. Mr. Edison's latest dictum and poor opinion of German architecutre was not my impression. No one could sojourn in Germany, visiting such cities as Nuremberg, Munich, Frankfort, Dresden and Berlin, without being greatly struck with the artistic character of the architecture.

Finally, I am glad to be able to state that the sand-lime brick industry is thoroughly established in Europe, and has a splendid future before it.

ANNUAL MEETING OF CEMENT PRODUCTS EXHIBITION COMPANY.

The annual meeting of the stockholders of the Cement Products Exhibition Co. was held at the offices of the company, 72 West Adams Street, Chicago, on May 14. The routine business transacted consisted of the reading of the report of the treasurer and the election of new directors and officers. The treasurers' report showed that the expenses of conducting the New York, Chicago and Kansas City Cement Shows were $77,789.28, while the total receipts were $78,729.52, leaving a surplus on the year's operations of $940.24. By vote of the directors it was decided to expend this surplus on future Cement Shows.

Directors for the ensuing year were elected as follows:

Edward M. Hagar, President Universal Portland Cement Co.

Norman D. Fraser, President Chicago Portland Cement Co.

D. McCool, President Newaygo Portland Cement Company.

J. V. Shove, Secretary Peninsular Portland Cement Company.

W. E. Cobean, Sales Manager, Wolverine Portland Cement Co.

B. F. Affleck, General Sales Agent, Universal Portland Cement Co.

George S. Bartlett, Universal Portland Cement Co.

J. P. Beck, Manager Publicity Bureau, Universal Portland Cement Co.

The following officers were elected:

President—Edward H. Hagar.

Vice-President—B. F. Affleck.

Secretary-Treasurer—J. P. Beck.

Sentiments were expressed by the directors favoring the continuance of the Cement Show, the feeling being unanimous that the cement exhibitions which have been held in the past, have contributed a great deal to the advancement of the industry in advertising cement, cement products and cement machinery, and increasing the use of concrete.

It was decided to hold the Sixth Annual Chicago Cement Show in the Coliseum January 16-23, 1913, but to hold no shows in New York and Kansas City. It is possible that another exhibition will be held at some other point, although nothing was definitely decided upon.

CONCRETE FINISHING TOOLS.

A unique and suggestive folder is being sent out by the Arrowsmith Concrete Tool Co., Arrowsmith, Ill., under the caption, "It Cuts a Mighty Big Figure." The text presents in a concise and effective way the advantages of the Arrowsmith Concrete Finishing Tools, which are offered to the trade as revolutionizing the work "you are now doing daily on your hands and knees." The company states they are willing to send these tools to any one interested on a ten day free trial upon mentioning Cement & Engineering News in their request. An order card attached asks for free catalogue and details of the ten day free trial offer. It would be well to take advantage of this opportunity.

OAKLYN PUBLIC SCHOOL
Oaklyn, N. J.
Built of Sand-Lime Brick.

A CATALOG FREE.

W. E. Dunn Manufacturing Company, 4139 Fillmore street, Chicago, are mailing to those who request it a copy of their handsome new catalog, giving the description of the different lines of cement working machinery manufactured by them, absolutely free and state that they are willing to answer any and all questions asked them by the dealer relative to the concrete industry. A postal or a letter will bring you a lot of valuable information concerning machines for making building blocks, concrete brick porches, chimneys, silos, concrete drain tile, etc.

FREE BOOKS ON CULVERTS.

If you are interested in the construction of concrete culverts, write the Merillat Culvert Core Company, 640 Main street, Winfield, Iowa. They will be glad to send, free of charge, their new book on concrete culverts to any of our readers. It is very interesting and contains cost data and many fine illlustrations.

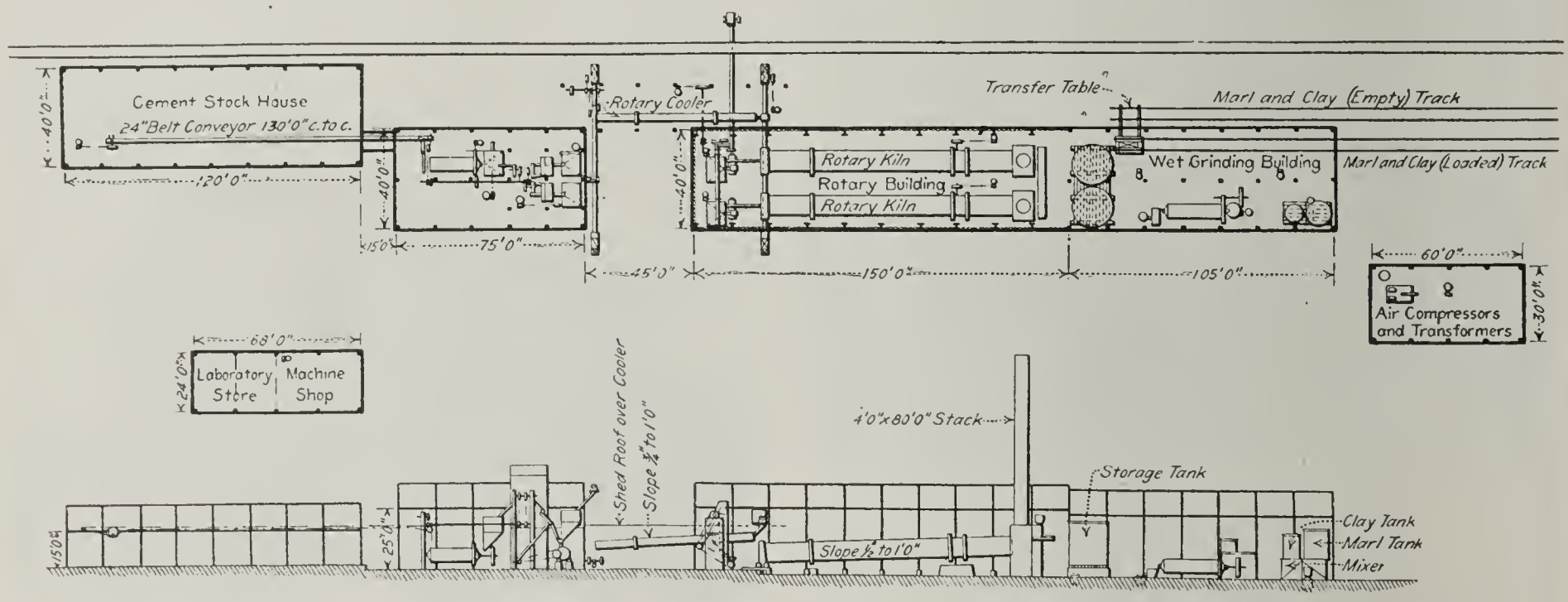
Plant of the Odgen Portland Cement Company

The works of the Ogden Portland Cement Company are located at Baker's Spur, Utah, in a region where a deposit of lime in the form of marl has apparently been formed at the foot of the canyon by the Wasatch Creek flowing down through limestone and shale ledges from the Wasatch mountains. This basin, as the Salt Lake receded, became known as Box Elder Lake. The water has receded until it now covers only a small portion of the deposit, about 300 or 400 acres at the lower end. The peculiar features of the deposit are that it is exceedingly uniform, varying less than 1 per cent over its entire area, and extends to a depth of from nothing at the edges to about 10 feet over the greater part, with nothing lying above it. Directly underneath is found a plastic blue clay.

The marl carries about 83 or 84 per cent carbonate of lime and about 10 to 12 per cent silica, the silica being in a very finely divided state, all passing a 200-mesh screen; it is fine enough to combine readily with the lime in rotary kiln practice. The clay is of unknown depth and is of a very fine texture, all of it passing a 100-mesh screen; it is believed to be of excellent quality for the manufacturing of cement. The marl as it comes from the bed is also exceedingly fine, so that the raw slurry from the tube mill without any grinding leaves a residue on a 100-mesh sieve of only about 5 per cent of lime flakes. The fact that the materials are found so uniform and with no foreign matter overlying them makes the excavating a simple proposition. On this work a Browning crane and an orange peel bucket are used. Another peculiar feature is the fact that the materials carry about 4 per cent of salt as they come from the pit. Theoretically it has been determined that this salt in rotary kiln practice would vaporize and pass out of the stacks, and this has proven to be the case in practice, as the cement produced contains but a very small percentage of the alkali

The property was first surveyed and examined about three years ago by Mr. W. G. Bell, president and general manager of the company, and after investigations had been made by others there was built and put into operation a 600-barrel plant. The plant was designed and erected by Mr. Bell, assisted by Mr. E. N. Hanlon, Mr. G. C. LaRue, and C. R. Mabee, chief chemist of the company. Construction began in July last, and the works were put into operation Jan. 5, 1910, or about six months after work was first started. The plant is a simple one, being operated by electricity secured principally from the company's power plant in Wasatch canyon, a distance of 2½ miles from the plant, and the balance from the city of Brigham, a distance of 7 miles. The works receive 4,000-volt alternating current, which is transformed at the plant to 440 volts for Allis-Chalmers motors.

The raw material is dumped into the pug mills and plugged into a stiff slurry which contains, when ready for burning, about 38 per cent of water and is handled by the Bell patent compressed air pumping system. The slurry from the pug mills is delivered into preliminary tanks, where the chemist samples it, and from these tanks is ground through an Allis-Chalmers tube mill to improve the mix. From the tube mill the slurry is pumped into big storage tanks behind the kilns and from these tanks is fed into the kilns. There are two 7-ft. 6-in.x 100-ft. Allis-Chalmers kilns, running at one revolution in three minutes; Aero pulverizers are used



Plan and Elevation of the Ogden Portland Cement Company's Works.

in firing. Kemmerer coal, of about the same quality as West Virginia slack, is passed from the cars directly to the Aero pulverizers without any preliminary grinding except to pass through a small crusher to take care of any big lumps.

The materials burn in the kilns without any apparent ringing, and the clinker, which is about the size of peas, or a trifle larger, is very easy to pulverize. The clinker drops from the kilns into a Webster bucket conveyor which delivers it in turn to a 36-in. x 64-in. rotary Allis-Chalmers cooler, which in turn delivers it to another pivoted bucket Webster conveyor which elevates it to the bins in the dry grinding.

In the preliminary dry grinding Sturtevant ring roll mills are said to be giving excellent results at Ogden. Two of the larger size mills deliver clinker, about 50-mesh fine, to the tube mill for finishing. The elevating and conveying machinery is of the special heavy type. The screening behind the Sturtevant mills is done by the Newaygo separator, the invention of Mr. Bell. From the finishing tube mill the cement is elevated to a belt conveyor which carries it through into the stock house. As yet no machine has been adopted for packing. The machine shop and laboratory equipment is about the same as usually found in cement plants.

The company owns about 2,000 acres containing enough marl by actual measurement to make about 60,000,000 barrels of cement. The entire plant is operated with about 45 men and low costs of production are anticipated. The company maintains its own boarding house at the plant, keeping there about 30 men, the balance driving back and forth to the City of Brigham, five miles away. The plant is located on the main line of the Oregon Short Line railroad and operates its own locomotive for hauling in raw material and handling cars on the side track. Provision for enlargements in units of 600 barrels each has been made. The buildings are wood frame covered with steel lath and cement, except the rotary building, which is entirely of steel. The plant cost $200,000, power plant and preliminary charges included.

CARLOAD LOTS.

For many years it has been the custom of dealers to place their orders for carloads of cement in round numbers, such as 100, 150, 200 or 250 barrels. None of these figures, however, represents a carload. Every dealer knows that box cars are built and marked with a certain capacity. These capacities are 40,000, 50,000, 60,000, 80,000 and 100,000 pounds. There used to be a 30,000 pound car, but none of these have been built for many years, and this size no longer is an element in transportation problems. Even the 40,000 and 50,000 pound capacity cars are very scarce and rapidly disappearing. The maximum load which can be placed in any car is ten per cent in excess of its marked capacity.

It is a well recognized fact that the railroads in the United States for the last three years have purchased only such cars as necessity compelled them to buy. Furthermore, many of them have permitted their rolling stock to reach a bad state of repair and have done but little to restore it to usefulness. The result is an actual defiecit in this country of several hundred thousand box cars in the number required properly to handle the country's freight.

The duty, therefore, of extracting from every car its maximum service is apparent to all. The railroads quite reasonably dislike to have their cars loaded below capacity, because this reduces pro rata the efficiency of the available rolling stock. In other words, if a car which will hold 280 barrels of cement is loaded with 150 barrels, there remains 130 barrels of wasted room in the car, and to waste room in box cars today is little short of criminal. For the information of our dealers, therefore, we publish the following table of carloads of cement:

Marked Capacity of Car	Maximum Load
40,000 lbs.	115 bbls.
50,000 lbs.	140 bbls.
60,000 lbs.	170 bbls.
80,000 lbs.	230 bbls.
100,000 lbs.	280 bbls.

Railroad tariffs in different territories provide different minimum weights for carload shipments of cement, ranging from 38,000 to 50,000 lbs. and in the case of certain short hauls, the minimum is 60,000 lbs.

If the dealers will bear these figures in mind when ordering cement and will specify quantities corresponding with the above specified maximum loads and, of course, subject to the minimum weight restrictions applying in their respective territories, it will materially assist the railroads and the manufacturers, and greatly facilitate the movement of freight.

Every car that is loaded to less than capacity imposes upon some other car an undue burden. An accumulation of such burdens means that from 50 to 100 per cent more cars are required to do a given amount of work than would be necessary if all the cars were loaded to the limit of their carrying capacity.

Further than this, everyone owes it as a duty to the public at large to assist in conserving the existing car supply to the greatest extent possible.

The following paragraphs will make clear how maximum service can be obtained from the available car supply:

"One car, any size." This is the way we would like to have an order read when it is immaterial to the dealer whether he gets a car of the minimum weight prescribed in the railroad tariff, or the largest car which may be available, loaded 10 per cent in excess of its marked capacity.

"One car not to exceed 170 barrels." This is the way an order should read when a car ranging from minimum to 170 barrels is what is wanted. In this case we can use a 40,000, 50,000, or 60,000 pound car, whichever is easiest obtainable, and load it to the maximum.

"One car, 170 to 280 barrels." An order reading in this way will enable us to use either a 60,000, 80,000, or 100,000 pound capacity car.

It is impossible to over estimate the importance of this matter, and until the railroads equip themselves with sufficient rolling stock to perform the work they are called upon to do, no dealer should order cement in other units than the above mentioned carload lots. Our dealers are urged to give this matter careful study and to properly instruct their employees who may have to do with placing shipping instructions. Co-operation between the shipper and consignee along these lines will be of marked benefit to both parties as well as to the railroads and other shippers and consignees. Let us, therefore, forget the old, familiar and convenient figures—100, 150, 200, and 250 barrels—and substitute therefor the proper and logical figures—115, 140, 170, 230, and 280 barrels.

CEMENT SEWER PIPE.

It has recently been brought to our attention that the rights to use the Thomas glazed cement sewer pipe machine in the state of Washington have been bought up by the clay pipe interests. Evidently their campaign to discredit the use of concrete sewer pipe by circulating broadcast literature "knocking" cement pipe has not accomplished its purpose in that part of the country and it has become necessary for them to resort to still other means for preventing the use of cement pipe. On account of the high cost of vitrified clay sewer pipe in the West, machine made cement sewer pipe have been used extensively since bell end cement sewer pipe machines were put in operation in that market.

The purchase of the territorial rights of one such machine will not materially discourage the manufacture of this kind of sewer pipe as there are several of these machines on the market which will undoubtedly be installed.

Concrete Blocks

Fundamental Principle of Good Block Making Presented by a Practical Man

By S. F. Phipps

The first and one of the important conditions of good block making, is the selection of the location for the plant. In starting a plant one must be sure that there will be a demand, or that a demand can be created for the use of the manufactured product. You should take into consideration the cost of sand and gravel and whether blocks could be made in some other locality and shipped to place where same is to be used cheaper than they can be made at this point, at a profit. The concrete block plant should be located upon a railroad, as this will save the expense of hauling cement, coal, sand and gravel, and these nearly always can be bought in carloads for less than they can in small quantities. The location should be such that in hauling the finished product to any part of your city you would have good roads. If your sand and gravel comes from banks near by, you would still have a saving on your cement and coal by being located on a railroad track, and when shipping out cement products you would save the expense of hauling same to cars. It is well to bear in mind that a location that will afford good advertising, or in other words a location that is passed by a great many people, is a great advantage. If your plant is easily reached and not stuck away in some out-of-the-way district, it is much easier to get the architect, contract and builder to go and see your product. You must figure that you must advertise, the same as any other business, to grow and receive your share of the trade.

In starting a plant you must study the wants of your community and the amount of business that you will probably be able to do. You must be acquainted with the cement block business or be able to employ someone who is, to be able to start in the right direction. You must remember that concrete blocks alone will not make a profitable business. After you have studied the above points and have come to some conclusion as to the amount of product that you will want to turn out, then you can take into consideration the amount of capital it will take to run the business. You should have quite a little working capital after your plant is installed and paid for. Do not locate your plant in low ground unless you are able to fill the same so that water will not stand in your yard, as generally your heaviest business is done in the factory in bad weather, when you are unable to do outside work, and in low, soft ground it is almost impossible to haul a reasonably good load out of the yard and teaming is one of your biggest expenses. In buying your cement, be sure and buy a good Portland cement that will work under all conditions and produce a good material. The care of the cement is an important factor in your business. It should be stored in a dry storage house, which I will describe later.

Sand and gravel or crushed stone.—A great deal of care should be taken in the selection of these materials. Sand for concrete block work should be reasonably coarse and sharp; it should be free from all loam or as nearly so as it is possible to obtain. The gravel should be of a good grade and clean, the same as the sand. If necessary to obtain good results, these materials should be washed. If crushed stone is used it must be free from dust. To obtain good results in concrete blocks your gravel and crushed stone should not run larger than from a half to three-quarters inch and your proportions should be as nearly accurate as can be obtained under your conditions. Under no circumstances should you guess at the amount of your material, but in all cases measure them, and if your proportions are right you will always obtain the same finished product and your blocks will always be uniform in color and strength.

After your location is obtained and your sand and gravel or crushed rock are found to be suitable for the work, and the capital, which is the most important side of the business, you are then ready to begin the erection of a proper building and to purchase machinery and equipment for your business. There are many different ways to erect a building suitable for the concrete block business, but many of them are built entirely too small, and are not equipped with sufficient machinery to manufacture cement products at a saleable cost. I will not go into the size of factory at the present writing or the cost of same, but wish to state that one of your first considerations should be the storage of your cement. The size of this bin or warehouse will depend, of course, upon the output of your factory, but in no case should it have a capacity of less than three hundred barrels, which is two medium size cars. The best factory that can be built is of concrete blocks and the room for the storage of cement should then be stripped with two by fours covered with paper and then sheathed over with inch flooring. The floor should be raised off of the ground, and should be a double floor with an air-space between. The ceiling should be the same; the windows should have extra doors so they can be closed and the room kept dark. The cement should never be piled against the wall. If you will follow these instructions you will have very little waste in cement and few, if any, complaints against the cement manufacturer as to the grade of his cement. You should never unload a car of cement during a rain. In connection with your plant you should have a suitable sized office to transact your business; you should also have a work room, or in other words, a carpenter shop, where your special forms can be made, and a room for special concrete work such as window and door sills, caps and any other special piece of work that can be made without interfering with the running of the rest of your plant. You should have your boiler room in which is installed your boiler for your heating and curing room, also your coal bin and curing rooms enough for two days' run. These should be divided into small rooms that will not exceed a half day's run. Your sand and gravel room should be large enough for a week to ten days' run, and if possible to hold larger quantities for use in the winter months. After you have all these apartments, and your heating plant arranged to heat them all, the question of equipment is an important one. To be able to manufacture concrete blocks and to sell them at a profit, your plant must be properly arranged and your equipment as near perfect as it is possible to get it. There should be conveyors to carry the sand and gravel from the bins to the mixer. The mixer should be of sufficient size so that your material will be well mixed. I found by experience that it should be mixed about three times as long as required by the ordinary mixer, and your proportions should all be

measured and not guessed at. When the material is well mixed it should be delivered to a table or chute that will convey it to the concrete block or brick machine. Your block machine should be a machine that is capable of producing a block that has sufficient moisture in it to start crystalization without adding any more moisture.

To produce the best results you should have some kind of a power tamper, as hand tamping is very unsatisfactory, as a man is never able to tamp as well in the evening as in the morning. When the blocks are made they should be loaded up on cars and transferred into the curing rooms and should remain there from thirty to forty-eight hours, when same should be transferred into the yard and put into piles.

GROUTING ON THE CATSKILL AQUEDUCT.

The last stage in the construction of the circular concrete-lined pressure tunnels of the Catskill aqueduct, which will deliver a daily water supply of at least 500,000,000 gallons to New York City, consists in grouting such points as may exist in back of the lining and making tight any seams in the rock through which the tunnels are driven, for when the tunnel is filled with water there would be considerable outward leakage, due to the unbalanced heads on the siphon, if all water-bearing seams were not plugged up. These pressure tunnels are used where deep and broad valleys must be crossed. There are seven of them, totaling 17 miles, with a diameter of about 14 feet. On the Wallkill pressure tunnel the grouting has been done by the use of a very unusual arrangement of Ransome-Canniff grout mixers with which the contractors, the Degnon Contracting Co., have made a wonderful grouting record, as they have put in on the average a batch of grout every thirty seconds. This speed will be appreciated when it is noted that the best record ever made with a paddle mixer is stated to be a batch every three minutes.

This particular outfit consists of four Ransome-Canniff grout mixers and an air compressor, set up on a heavy platform on wheels. The mixer nearest the compressor is used exclusively as an air receiver. The other three mixers are connected up in a battery, but the end one is so connected that it can be shut off from the other two mixers and used separately. By this arrangement the three mixers can work together under any pressure up to 300 pounds, and if necessary the end mixer can be cut off from the other two and worked separately under 300 pounds' pressure while the other two mixers continue to eject under 75 and 100 pounds' pressure. This has resulted in a large saving of time and expense. It should be added that the rear end of the platform is used to pile bags of cement upon and from this point the cement is emptied into the three hopper-like affairs above each mixer. With these Ransome-Canniff grout mixers the contractors are grouting 24 hours a day, divided into three 8-hour shifts, and an average of 200 or 300 lineal feet of tunnel has been grouted per day.

With the old style of paddle mixer considerable time is lost in machinery breakdowns, which occur very frequently, due to the rather elaborate mechanism necessary. It is impossible in the operation of paddle mixers to keep the grout from getting into the bearings which hold the shaft at each end, and the result is that the bearings are generally rendered useless and have to be replaced about every two weeks. Taken as a whole, every part of a paddle mixer in steady use has to be replaced on the average of once a month. Furthermore, with the paddle type of mixer, additional apparatus is required in order to convey the grout to its final destination. On the other hand grout mixers of the Ransome-Canniff type are simple in design and do not get out of order.

On the Rondout pressure tunnel grouting is also in progress. Ransome-Canniff type of grout mixers are used, a battery of three mounted on a car being connected up to two 9½x5x10-inch air compressors. The compressors are used to raise the pressure to 350 pounds when necessary, the normal direct-line pressure being only 100 pounds. An air compressor made of a piece of 12-inch wrought iron pipe 5 feet long is used between the compressor and the tanks. The consistency of the grout used here was generally a 1 to 1 mix, with sufficient water to lift it into place wherever possible.

The Degnon Contracting Co. are executing the entire contract for the Wallkill pressure tunnel and while the Ransome-Canniff grout mixers were manufactured by the Ransome Concrete Machinery Co., the outfit was designed by the superintendents of contracting company.

MONEY IN CONCRETE ROOFING TILE.

We have often called attention in these columns to the golden opportunity represented by the roofing tile industry. We believe that nine out of ten concrete products factories could make a roofing tile equipment pay. With a tile machine the manufacturer can keep his plant busy in the winter and at odd times in the summer, making concrete shingles for stock. Once a demand is created in a community, the business pays well.

L. Hanson, 2036 Penner St., Kansas City, Mo., is an old hand at the roofing tile business. He made concrete tile in Europe when the business was young over there. He manufactures the U. S. Champion machine for making concrete roofing tile and supplies some interesting data on the cost of manufacture. Cement, coloring matter and pallet oil used in making 1,000 shingles cost, he has found by averaging figures in different plants, $6.50. Sand for 1,000 tile will cost $1.50 and labor $10.00, a total of $18.00 for the batch. These 1,000 concrete tile will cover from 650 to 675 square feet of roof. If you know the price of clay tile, tin, wood, shingle and slate in your city you can easily figure out the chance offered for concrete roofing tile.

WASHING SAND AND GRAVEL.

Mr. S. H. Brown, president of the Hawarden & Lake View Sand & Gravel Co., Lake View, Iowa, made a short address before the Iowa Cement Users Association's annual convention concerning the washing of sand and gravel for concrete work and their plant at Hawarden, as follows:

"The attacks being made upon concrete by rival interests only tend to strengthen the position of concrete. The increase in the consumption of cement proves conclusively that the industry is founded so firmly that nothing that can be said can stay its progress.

"It is superfluous for me to attempt to explain to you, gentlemen, the progress cement is making at the present day. You know that better than I can tell you. So I will only say that in the use of cement sand and gravel are some of the important ingredients —in fact, just as important as cement. While this is called a "cement" show, the sand men are permitted to attend, exhibit their wares, and Mr. Williams tells me, hereafter they will receive more consideration because "you have got to have the sand."

"The market in Chicago and all the larger cities demand that material furnished for concrete work be washed and screened. We could see the increasing necessity for washing and screening all material placed on the market for concrete work. It therefore became necessary for us, as well as many other producers, to inaugurate, in connection with sand and stone plants, a system of washing and screening the material. You all know that when you give your plans or your contract to an engineer, or an architect, he specifies that the material must be washed and screened and all foreign substances removed.

"In looking about for a washing machine to fit our plant, we visited plants in Nebraska, Iowa, Illinois and Indiana. We decided the machine best adapted to the handling of our material was similar to those used in the Coon river in the locality of Des Moines, Ia., where every pound of sand and gravel used in Des Moines is washed and screened. Every yard of sand and gravel and crushed stone used in the city of Chicago and other large cities is washed and screened, and it will be but a short time until every yard of sand and gravel used in Sioux City will be washed and screened. All the material used in the concrete work will have to be screened and washed, because, as has been stated before, Sioux City is second to none in the development of this very important industry, concrete. We have a sand and gravel plant on a 10-acre sand bar in the Big Sioux river at Hawarden, Iowa. After investigating washing plants, we decided a centrifugal pump was the plan best adapted to handling our material; we patterned after one of the plants in operation at Des Moines, with an 8-inch centrifugal pump operating on a barge, 47 feet long, 20 feet wide, 3½ deep, handled by a 12x14-inch engine, 80 H. P. boiler installed by the Globe Manufacturing & Supply Co. of Des Moines. We are able to handle about 10 or 12 carloads per day and the advantage of this machine is that we are able to convey, wash and screen in large quantities at the same operation. You catch my idea—the material is drawn up into the pump and forced through an 8-inch pipe into a large hopper, thence on to screen, the coarse material going over the screen into one pile, the sand and refuse going the other direction, furnishing a clean and very desirable product. It is dumped into large receptacles on about a level with the pump, from where it is picked up with a clam shell and conveyed to the railroad cars for shipment. We have what is known as a 'Lidgerwood Cable Way,' which carries our material from the piles to the railroad cars where it is ready to ship to the market, and I feel like congratulating ourselves on the success of our machine in the short time we have used it.

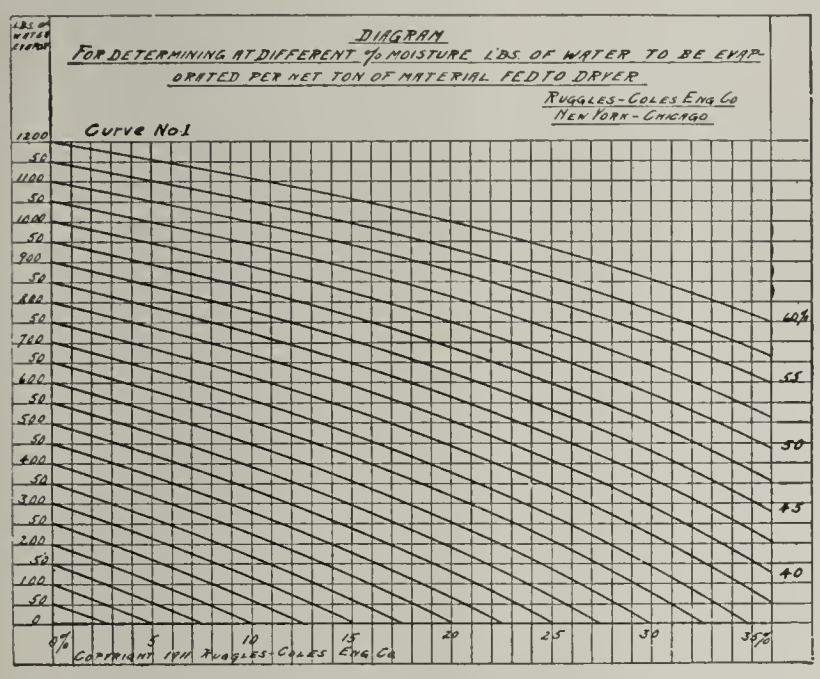
"In telling you about our sand plant, I will tell you about our Lidgerwood cable way, which works in connection with it, and consists of two towers 75 feet high, one on either side of the Big Sioux river, about a mile west of Hawarden. A two-inch cable extends from one tower to the other, on which travels a large carriage; suspended from this is a large clam shell bucket, with capacity of 1½ yards. It is controlled by an engineer on the head tower. The engineer has perfect control and can convey it with an endless cable to any point, where he can stop, drop it down, open, dip it up, bring it in and drop it on to the car. One man handles the entire movement. One of the strongest points in favor of this kind of a machine is this—you can bring in a full load every trip. It has a capacity of 500 yards per day. With our bucket the engineer is able to drop the bucket and fill another load in case he discovers he has not got a full load."

A MARION MODEL 60 WITH TWO AND ONE-HALF YARD BUCKET

Digging Sand and Gravel from the Bank, in the Pits of Gallagher Brothers' Sand and Gravel Co., New York, N. Y.

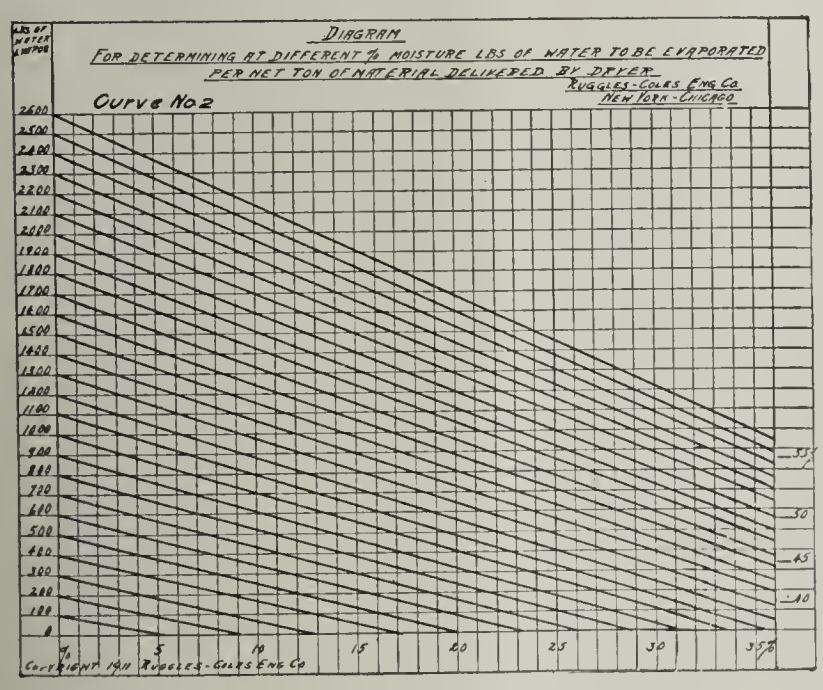
USEFUL CURVES IN DRYING CEMENT ROCK, CLAY AND SIMILAR MATERIALS.

Cement companies use dryers for treating cement rock, clay and other argillaceous materials as well as for drying the coal so that it may be pulverized and made ready for the kilns. The amount of water to be evaporated in reducing a given ton of material from one percentage of moisture to another is often desired to be known quickly. The curves prepared by the engineering staff of the Ruggles-Coles Engineering Company fill this need and are reproduced herewith.



To make the use of these curves clear take a specific case of reducing cement rock from 6 per cent moisture to 1 per cent. Referring to curve No. 2, follow the diagonal opposite 6 per cent at the bottom until it intersects the ordinate of 1 per cent. Then follow across to left and the figure 140 pounds is the amount of water to be evaporated per net ton of the cement rock delivered by dryer. Curve No. 1 is used in the same way and from it can be determined the pounds of water to be evaporated per net ton of material fed to dryer.

A considerable saving of time can be effected by the use of these curves and the Ruggles-Coles Engineering Co., 50 Church St., New York, will send blue prints of them on request.



CONCRETE RESERVOIR.

Of the ten tenders received for the construction of a covered reservoir at Kamloops, B. C., capacity 1,500,000 gallons, that of the Graff Construction Company, Vancouver, was accepted, their price being $32,729.89.

AUSTRALIA USING MUCH CEMENT.

[From Vice-Consul-General Henry D. Baker, Sydney.]

The increasing use of Portland cement in Australia for the construction of public works, private buildings, etc., where concrete is required, has led to recent advances in prices, so that in mid-October Portland cement was quoted in Sydney for the best brands, at $3.28, spot, per cask of 375 pounds; second brands, $3.04 to $3.15; local brands, $3.15.

At these prices local manufacturers aresaid to be making profits of over 100 per cent on the cost of production. Nevertheless, as they are unable, with their present plant capacity, to keep pace with the growing demand, the users of cement have recently been obliged to make extensive imports from other countries, chiefly Germany. The scarcity of cement has of late been a source of some delay in important public works. Although it is the policy of the various state governments in the construction of works to buy cement only from local manufacturers, an exception lately has been made to this rule, owing to the inability of local plants to supply what is required.

As there are rather extensive cement deposits in different parts of Australia, chiefly in New South Wales and Tasmania, and the local industry is protected by a tariff of 24 cents per 112 pounds, as well as by the disposition of the local governments to patronize the local product, it is likely that in the future there will be considerable development of this industry in Australia to meet the increasing needs of consumers.

In recent visits to parts of New South Wales where dams for irrigation purposes, railways, etc., are under way, I had occasion to notice the popularity of American machines for mixing concrete. One special advantage they are said to have over machines made in England, the only other country from which they seem to be extensively imported, is in their greater convenience where small space is available and where there are natural difficulties in securing large space.

As an illustration of the local uses of concrete, I might mention the Wallarobba tunnel, some 330 yards through, on a government railway line now being constructed in New South Wales. This tunnel has given considerable trouble, several serious falls having occurred recently, and it was decided to concrete it. Thousands of tons of concrete are being utilized, and a concrete mixer was imported from the United States, which turns out a truck full of concrete every minute or two. Huge molds are built outside the tunnel, hauled in on the rails, and placed in position, the concrete being then emptied between them and the wall. The molds are so constructed that the engine and trucks can run through without disturbing them in any way.

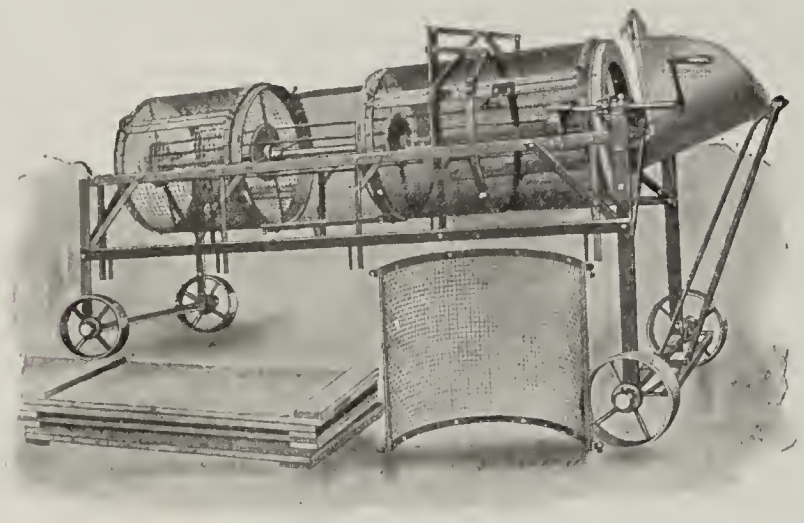
Very extensive irrigation works are now under way in different parts of Australia, and in several instances concrete walls of immense height are being built for impounding the waters. In New South Wales 50,000 tons of cement are being used in the construction of the Barren Jack dam. The height of this dam is 240 feet, length of crest 784 feet, thickness at base 170 feet and at crest 18 feet. Another great dam which will likely soon be built to increase the water supply of the city of Sydney, as well as for irrigation purposes, will, if constructed as proposed, have a height of 275 feet and be one of the highest concrete walls in the world.

For ordinary building purposes the local use of concrete is being stimulated by increasing popular knowledge of its advantages and by increasing cost of timber. There is great activity in building at Sydney

and other leading cities in Australia, due to the prosperity of the country arising from a succession of good years for the primary industries of sheep raising and wheat growing, which have caused "boom" times in every branch of business. It is stated that contracts for new buildings in Sydney alone amounted last year to about $30,000,000.

WELL GRADED AGGREGATES.

At present more attention is paid to the careful grading of sand, gravel and crushed stone for making concrete than formerly. Tests with different grades and mixtures of aggregate have shown that it is cheaper and more satisfactory to balance carefully the sizes of aggregates in a mass so that the voids and spaces between the larger particles are filled with smaller pieces of the same material, than it is to attempt to fill all of the spaces with cement.



Ready to Move. Shows Removable Sections and Partitions.

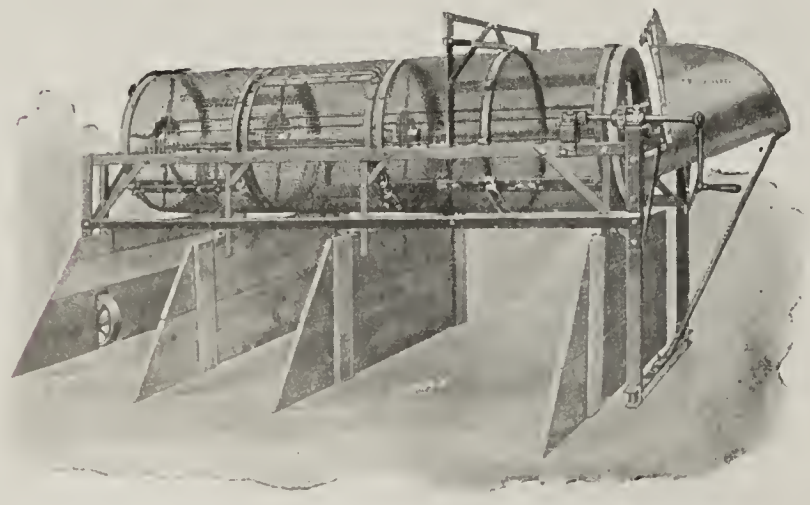
The contractor or builder who does this cheaply, easily and successfully uses a rotary screen to aid him in sorting his materials so that he may again mix them in the proper proportions for best efficiency.

The rotary screen shown in the cut is manufactured by F. S. Converse. If we were to analyze this machine we should find that each section is made of two half-sections, attached to the cylinder by only six bolts, so they may be easily changed to those having other sized spaces. The sections are interchangeable.

The partitions are removable by turning the turnbuttons on the posts. (Purchaser makes partitions from any rough boards.)

To run by power, remove the crank and substitute a pulley. Crank is located at feed end at a comfortable height, enabling one man to operate, if desired, by alternately filling hopper and turning crank. Chain transmits the motion from a small sprocket on crankshaft to a large sprocket on main shaft, thus taking less power.

If desired these screens are furnished with electric motor mounted on the screen frame. Prices, circulars, etc., will be submitted by applying to Cement and Engineering News, 1117 Schiller Bldg., Chicago, Ill.



Rotary Screen Ready for Use—Turned by Hand or Power.

CANADIAN CEMENT PRODUCTION LAST YEAR.

Complete statistics have been received from the manufacturers of cement covering their production and shipments during the year 1911. These returns show that the total quantity of cement made during the year, including both Portland and slag cement was 5,677,530 barrels as compared with 4,396,282 barrels in 1910, an increase of 1,281,257 barrels, or 29 per cent.

The total quantity of Canadian Portland cement sold during the year was 5,635,950 barrels as compared with 4,753,975 barrels in 1910, an increase of 881,975 barrels, or 18.5 per cent.

The total consumption of Portland cement in 1911 including Canadian and imported cement and neglecting an export of Canadian cement, valued at $4,067, was 6,297,866 barrels as compared with 5,103,285 barrels in 1910, or an increase of 1,194,581 barrels, or 23.4 per cent.

Detailed statistics of production during the past three years are shown as follows:

	1909 Barrels	1910 Barrels	1911 Barrels
Portland cement sold..	4,067,709	4,753,975	5,635,950
Portland cement mnftd	4,146,708	4,396,282	5,677,539
Stock on hand Jan. 1..	1,098,239	1,189,731	844,741
Stock on hand Dec. 31.	1,177,238	832,038	903,590
Value of cement sold..	$5,345,802	$6,412,215	$7,571,299
Wages paid	1,266,128	1,409,715	2,103,838
Men employed	2,498	2,220	3,010

The average price per barrel at the works in both 1910 and 1911 was $1.34, as compared with an average price of $1.31 in 1909 and $1.39 in 1908.

The imports of Portland cement during the twelve months ending December 31, 1911, were 2,316,707 cwt., valued at $834,879. This is equivalent to 661,916 barrels of 350 pounds at an average price per barrel of $1.26. The imports in 1910 were 349,310 barrels, valued at $468,046, or an average price per barrel of $1.34.

The imports from Great Britain during 1910 were 190,506 barrels, valued at $210,839; from the United States 441317 barrels, valued at $575,768; from Belgium 2,683 barrels, valued at $2,019; from Hong Kong 22,059 barrels, valued at $38,292; and from other countries 5,351 barrels, valued at $7,962.

Following is an estimate of the Canadian consumption of Portland cement for the past five years:

Calendar	Canadian		Imported		Total
Years	Barrels	Per cent	Barrels	Per cent	Barrels
1907	2,436,093	78	672,630	22	3,108,723
1908	2,665,289	85	469,049	15	3,134,338
1909	4,067,709	97	142,194	3	4,209,903
1910	4,753,975	93	349,310	7	5,103,285
1911	5,635,950	89.5	661,916	10.5	6,297,866

SHIPPING CEMENT IN BAGS.

Another Way in Which Manufacturers Are Seeking Economy.

Some years ago a cement manufacturer was shipping all his product in barrels. Each barrel cost him about thirty cents delivered. Once shipped this barrel was valueless, since it could seldom be sold as second hand and it would cost more than its original value to be returned.

He made an experiment with sacks, four holding as much as one barrel. The sacks cost ten cents each, says "Business," but they could be returned again and again until they really cost him considerably less than his barrels.

The dealers were glad to co-operate with the manufacturer. They added a few cents to the selling price to provide for a rebate for the return of the sacks.

This manufacturer also has a second grade of sack made of paper which he uses in shipping to nearby stations. Once shipped it is worthless for reuse, but its initial cost is sufficiently low to offset this fact. In order to guard against damage from moisture it is often advisable to use barrels where shipments may be endangered by weather conditions or rains, although there are other ways to meet this problem.

A firm on the California coast was shipping hydrated lime to the Hawaiian Islands, and except for a few serious complaints about wet sacks its trade promised well. The actual monetary loss on account of ruined shipments did not exceed two or three per cent, but the loss of customers was not to be lightly passed over. The remedy was a waterproof bag put inside the burlap bag. This bag, bearing the company's name, proved to be an excellent advertisement as well as a satisfactory container.

Another cement manufacturer who made use of bags had trouble in getting them tied securely. Unskilled men did not sew them well enough to guard against their being torn open. A saving was effected when he made use of a small tier, using wire instead of twine. This device is manufactured by the United Wire Tie Company, Department C, 1342 Nicholas Bldg., Toledo, Ohio.

The tie, being mechanically made, is uniform on every bag; it will not slip or break and can be drawn more tightly than was the case with twine. The wire is easily untwisted by a simple movement of the thumb and forefinger. No knife is necessary, hence no bags are ruined by being cut. Fewer men and better work results are the record now in the bagging department.

CONCRETE POLES FOR NEW ZEALAND.

Wooden telegraph poles will soon be a thing of the past in New Zealand, says the New Zealand Herald. In the future they will give place to the more durable poles made of ferro-concrete.

These poles will present a more pleasing appearance than the wooden poles.

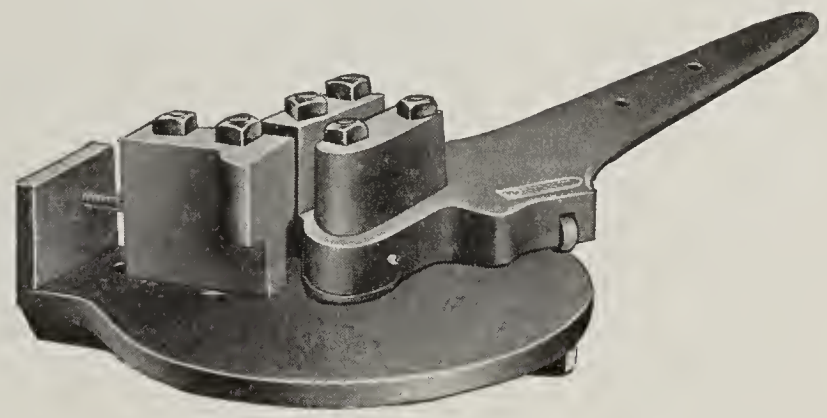
For more than a year experiments have been carried on for the department, with the object of making a concrete pole that would be much lighter than those made from the ordinary ferro-concrete. The experiments have been successful.

Poles can now be manufactured which are very little heavier than totara wood. Tests recently made with an 18-foot pole showed that it could carry a greater weight than either wood or iron.

SAGINAW SAND-LIME BRICK CO. EXPANDS.

The Saginaw Sandstone Brick Co. has just installed a new engine at its plant and also a second press. Other machinery is being placed. When the improvements are completed the plant will have a capacity of 55,000 to 60,000 brick per day. One of the units will be started next week and the second a week after. The plant was shut down about two weeks ago after having been run all winter. The improvements will more than double the former capacity. Speaking of the sandstone brick business, John L. Jackson, president of the Saginaw company, said: "The business here is satisfactory and several of the stockholders are stockholders in other companies in this and other states that have been organized to manufacture sandstone brick by the system we introduced. The plant at Jackson has recently been purchased and is being removed to Rives Junction, from which point both Lansing and Jackson can be supplied. Our company has secured the Michigan City plant, where our system will be put in."

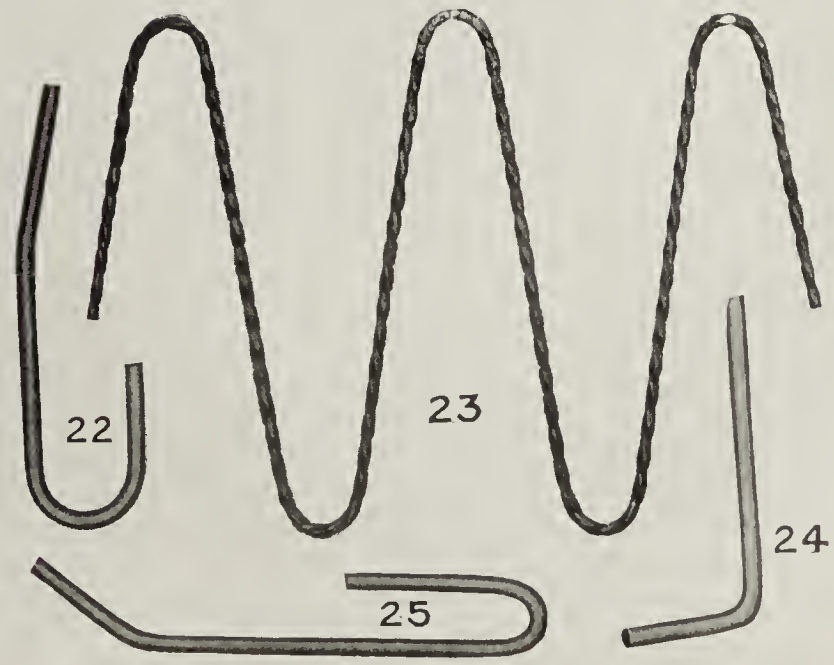
The Saginaw company has but few brick on hand and the increased capacity will not overstock the market.



NEW REINFORCING BAR BENDER.

Concrete contractors who use reinforcing steel will be interested in a new device that may be easily transported from one job to another for bending reinforcing rods. This bender is made by the Wallace Supply Co., 123 N. Jefferson St., Chicago, Ill. It is mounted on a substantial metal standard.

This device will bend plain or corrugated steel rods of high carbon stock, cold, its capacity running up to 1¼-inch steel. It is operated by one man. The dies are adjustable by set-screws to suit the thickness of the steel to be bent.



New Plant of the Barnes Sand and Gravel Co.

Gravel men will notice at once that the plant pictured here differs from the usual arrangement in having its inclined conveyor swung through an angle of 180 degrees, bringing it up over the screens and bins instead of from the opposite direction.

This "somewhat different" arrangement, on second thought, will show two evident advantages, a saving of ground space for the whole plant and a saving in cost of supporting structure for conveyor. Economy of ground space may or may not be of importance, according to conditions, but cost of construction is always a matter of moment. There is also the further minor advantage of easier access to return belt and rolls of the conveyor itself. The plant as a whole, too, with its power house beneath the lower reach of the conveyor, has a compact and self-contained appearance that makes natural appeal to the mechanical eye.

From the hopper the sand and gravel are flushed by an ample stream of water into and through the screens. The screens are of conical type, in series of three, with 1¼ in., ⅝ in. and ⅜ in. perforations. The structure is designed for two series of screens, but only one has as yet been installed.

A ready market is found for the over-size gravel tailing from the 1¼ in. screen. Not many large bowlders are encountered and these are readily separated out by hand picking from the belt conveyor as the material is being elevated. Medium gravel, ⅝ to 1¼ in., and roofing gravel ⅜ to ⅝ in., are separated out by the ⅝ in. and ⅜ in. screens. A further separation of the sand into coarse and fine is effected by baffle screens of 6-mesh woven wire, against which the stream from the smallest conical screen is made to flow.

BARNES SAND & GRAVEL CO.
Gravel Washing Plant Near Piketon, Ohio.

This plant belongs to the Barnes Sand & Gravel Co., and is located near Piketon, O., a few miles north of Portsmouth, on the Norfolk & Western Ry. Here is a large acreage of sand and gravel, on the flat enclosed by a wide bend of the Scioto river. Beneath a surface of 15 feet depth of gravel lies a bed of 20 feet of coarse sand, with fine white sand to unknown depths below that. No wonder these deposits, worked first at Sargent's Pit and still known by that name, were drawn upon for roadbed materials when the N. & W. was built through between Columbus and Portsmouth.

The Barnes Company has 35 acres of this land, and for several years has been shipping dry screened materials. In 1910 the present washing plant was installed, and since that time the usual grades of washed material have been shipped. The washery is located, of course, close to the railroad tracks, the sand and gravel being brought from the pits in dump cars hauled by the company's own locomotive. The company has about one mile of private trackage between the pits and the plant.

Surface gravel is loaded by a ditching machine, with dipper, and the sand from below water level is dug by the same machine with a clamshell bucket. The loaded cars, usually two at a time, are hauled up out of the pit by the locomotive and taken to the plant where their contents are dumped into a concrete track hopper at the foot of the inclined belt conveyor. Belt conveyor is a 26-in. belt 200 ft. long on centers to the point of delivery of the materials into a receiving hopper at the top of the plant.

The plant is driven by an oil engine conveniently set in a power house immediately below the belt conveyor. Storage tanks for the fuel oil are buried in the ground just outside the engine room. This engine has proved a very economical and satisfactory prime mover, the fuel cost being only one cent per horsepower per 10 hours, and the wages cost for operation being limited to $60 per month for one man, no licensed engineer, fireman or watchman being required as for a steam plant.

The engine is belted to an overhead line shaft. At one end of which is a clutch pulley from which power is taken off and transmitted by countershaft out of doors and across an open space to the pump house for driving the pump by which water for the washery is supplied.

At the other end of the lineshaft, also fitted with friction clutch for independent control, is the driving sheave for the ropes by which power for actuating the conveyor and screens is delivered to a countershaft at the head of the conveyor. From this countershaft the conveyor is driven by spur gearing, and the screens by chain belting first to the middle screen and thence upward and downward to the others.

Water for washing is drawn from two wells and delivered by a 10x12 in. duplex power pump, driven by shaft from the engine house, as already noted. A 5 in. pipe is carried to the top of the washing plant, where 3½ in. branches are extended to the hoppers for each set of screens. At the tail of each screen also is a back jet for giving the gravel the desired brilliance by a final washing with clean water as it tails out.

Alongside the loading track is a standpipe and hose for use in cleaning the top of each carload before shipment. This is very effective in removing the dullness which the gravel is sure to show as drawn from the bins.

Storage bins on the ground, back from the regular loading track, are provided for receiving any possible excess of any one or more of the five sizes of material. Such excess may be loaded for shipment at any time by bringing the ditcher machine from the pit to the plant.

In addition to shipments of washed sand and gravel, running about 15 cars per day, much run-of-bank gravel is shipped for concrete construction work, and large amounts also of run-of-bank sand for pavement cushion work, etc.

Due to the character of the material and the excellence of its preparation in this admirable washing plant, the Barnes company's product is shipped to long distances over the N. & W. as far north as Columbus and as far south as Williamson, W. Va., selling throughout this territory in preference to the product of other companies, especially those which dig material out of the bed of the Ohio river. The Barnes product is sharp in its grading and clean in its washing; also more uniform and reliable in delivery, because the company suffers no delays on account of high water, the plant being set high and able to run even when the Scioto is out of its banks. Webster machinery is used with good success in this plant.

CEMENT SHIPPED BY WATER.

A new departure in the cement industry developed this month when the Atlas Transportation Company started on its first trip up the Mississippi with a steamer and five large barges loaded to the gunwales with Atlas Portland cement from the great Hannibal plant. Progressive as is this big concern, one not connected with the cement trade would not imagine the strides they have made in the last few years that brings them to the organization of their own fleet of river boats.

Everyone knows cement is being used in large quantities, and train loads leave the mills every day for all parts of the country to supply the cement workers with the material used so extensively for so many of our everyday needs, but it has again been left to the "Atlas" people to mark a new era in the history of cement by conducting a transportation line of their own on the Mississippi.

This line will run up the river as far as St. Paul, and down the river to New Orleans, and have connecting lines for both the Ohio and Missouri rivers. The large steamer "Josh Cook," flagship of the fleet, will tow a string of barges, leaving one at each distributing point on the way up or down the river. Atlas dealers will get their supply direct from these barges, and the steamer will pick up the empty barges on her return trip to Hannibal, where they will immediately re-fill, ready for the next trip.

The Keokuk dam, on which the Atlas Portland Cement Company is furnishing about one million barrels of cement, and second only in importance to the Panama canal in size, is being furnished cement by the Hannibal plant, while all the cement for Panama is being shipped from their mills located at Northampton, Pa.

DEVICE FOR CURB AND GUTTER CONSTRUCTION.

The year 1912 will see a larger increase in curb and gutter construction than in any other line of concrete work. It is only recently that municipalities, as well as individuals, began to realize what an improvement a well laid concrete curb and gutter is to any street. It took some time for the idea to spread but the past year has witnessed the laying of miles of it and the coming year the amount will probably be at least three times that constructed in 1911.

Improvements in curb and gutter construction are eagerly sought for by contractors everywhere, and numerous devices have been placed on the market for simplifying and cheapening the work. The devices exhibited at the cement show in Chicago last February attracted a great deal of attention. Some of them were in the nature of finishing or shaping devices and others had to do with the question of forms or molds. In view of the cost of lumber and the expense of setting up forms, the latter problem would seem to be the more important, and it is therefore interesting to note that the makers of the Hotchkiss steel sidewalk forms have now placed on the market similar forms for curb and gutter work. These forms were not put into general use until the middle of the past season, but since that time they have apparently been very successful. They are the product of the Hotchkiss Lock Metal Form Co., Dept. O, Binghamton, N. Y.

The steel forms in question consist of steel templates shaped to a cross section of the desired curb and gutter and having tongues projecting front and back for the attachment of the steel channels which comprise the front and back parts of the form. Any desired number of these steel channels may be used for the front and back molds. For a 6″ curb, which is 12″ over all, and an 18″ gutter, the usual custom is to use two 6″ channels at the back and one 6″ channel in front. This makes all of the front forms and back forms interchangeable and easy to handle. On the other hand, to suit the needs of contractors who wish to use the sidewalk and curb and gutter forms interchangeably, tongues are placed upon the curb and gutter templates at the proper intervals so that the 4″ sidewalk side rails may be used for the front and back forms.

The forms are locked together by lugs in the tongues of the templates which project through slots in the channels and therefore require no staking. The whole form may be set up in a few minutes and taken down and removed with equal speed. In practice, the forms are removed as soon as the surface is finished, as it is found unnecessary to leave the forms on while the concrete is settling.

The process of building the curb and gutter recommended for use in connection with the steel forms is to mix the concrete fairly stiff and to tamp it well after putting it into the forms. For curbs having more than a 7″ face it is recommended that reinforcing rods be used; these may be bent on the spot. As soon as the foundation course has been put in to the height of the gutter and well tamped, a 2″ plank rounded on one edge is set up as a mold for the face of the curb and secured in position against the templates by means of clamps or braces. The concrete for the curb is then put in and tamped down, taking care to face the curb with some top-coat or rich material. Top-coat material is then put on the top of the curb and also tamped. This method of putting in a top coat quite stiff and tamping it to bring just enough moisture to the surface for finishing immediately is an excellent part of the method as it is said to produce better results than

a wet mixture. The front mold of the curb is then removed and the whole surface struck off and finished with a wooden float, after which it is lightly brushed with a damp brush.

By proceeding in this way and removing the forms as soon as the surface is finished and setting them up farther on it is possible to use the same forms over and over again the same day and 50′ of forms are considered sufficient for constructing at least 300 running feet of curb and gutter daily.

It is claimed for these steel forms that they not only simplify the work and guarantee uniformity and accuracy, but also that they affect a very material saving, something like 10 per cent over wood forms.

CEMENT PIPE.

Harold Hooker, manager of the Spokane Concrete Company, Spokane, Wash., returned this morning from Kennewick, Wash., where the city awarded the contract for the installation of about 10,000 feet of pipe for a city irrigation system.

James Crowell of Kennewick was awarded the contract for the complete installation of the system, and the Spokane Concrete Company's cement-glazed concrete pipe will be used for the distributing lines.

"With the order given us last night, the city of Kennewick is using about three miles of our cement-glazed concrete pipe, for its municipal irrigation system," said Mr. Hooker.

TAYLOR MESABA CHAINS.

The Taylor Mesaba chains, manufactured by the S. G. Taylor Chain Company, 138 South Dearborn street, Chicago, has established a record as the longest lived steam shovel chain ever produced. It is a chain that keeps the steam shovels at work, eliminates waste time, increases yardage and cuts down expense. The leading contractors and cement, gravel and crushed stone producers throughout the country are now using the Taylor Mesaba chains on their steam shovels.

CONCRETE SILOS.

The interest in silos and silo building has tremendously increased in the last year. A comprehensive discussion and book of design on silos was published by the Universal Portland Cement Co., in their "Concrete Silos," which is now passing through its fourth edition of 20,000 copies.

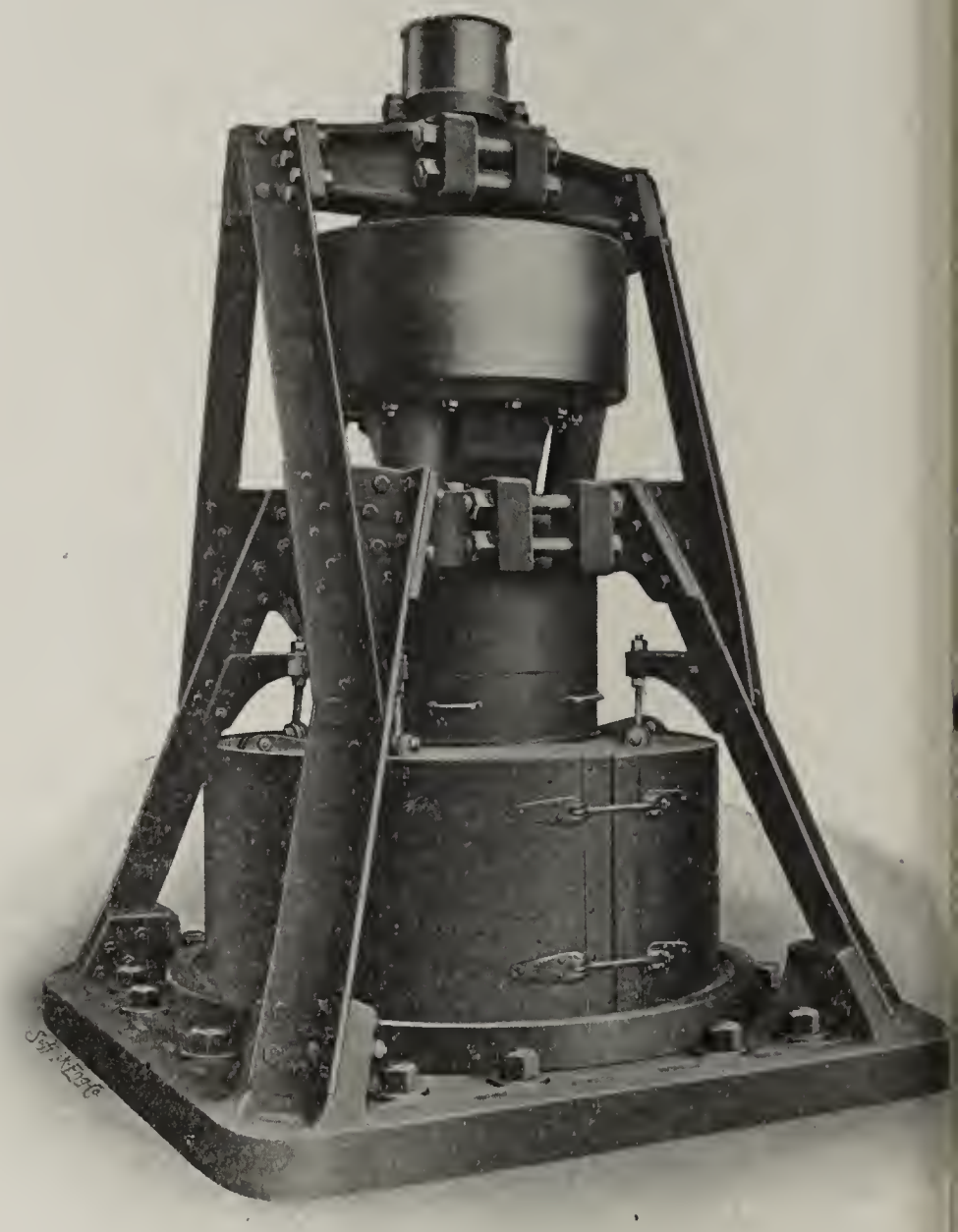
The farm press and agricultural colleges both give a large amount of attention to silos and are using this publication of the Universal Portland Cement Co., as a source of material and text book. The demand for concrete construction for silos as well as troughs and tanks for farm use has been greater than could be cared for by the local contractors in many districts, and it is probable that a profitable field for construction work can be found in silo building.

"CERESIT" IN THE SOUTH.

The Hurd building now under construction at Jacksonville, Fla., will be fifteen stories and basement with steel frame encased in concrete and concrete floors. The retaining walls will be waterproofed with from 15,000 to 16,000 pounds of "Ceresit," manufactured by the Ceresit Waterproofing Co., Clark and Adams street, Chicago, Ill. John Kevan Peebles, architect; Southern Ferro-Concrete Co., Atlanta, Ga., contractors for foundations and retaining walls.

REINFORCED CONCRETE PIPE.

The adaptability of reinforced concrete pipe for sewers and water conduit is explained in an attractive booklet issued by the Reinforced Concrete Pipe Co. of Los Angeles, Cal. The descriptive matter covers such points as the manufacture of the pipe on the ground by the wet process, forms, reinforcement, tests, sewers and water conduits. There is a list of nine reasons to support the claim that the company's pipe is superior to other forms of construction. One of the feature of the booklet is the variety and excellence of the photographic reproductions showing reinforced concrete pipe in various stages of construction. At the end of the booklet is a series of discharge and velocity curves for all sizes of pipe, arranged by Mr. N. D. Whitman, engineer for the company.



THE GRIFFIN MILL.

The accompanying cut illustrates the latest type of Griffin Mill, the excellent grinding machine, manufactured by the Bradley Pulverizer Co., of Boston, Mass. Many modern cement plants are equipped with dozens of these Mills and Cement Companies building new plants are installing them right along, so that the company is working at full capacity in order to fill the orders coming in for Griffin Mills.

MONARCH TILE MACHINE.

The Monarch Manufacturing Company, manufacturers of Monarch cement tile and block machines, Onawa, Iowa, is forming a corporation, with a capital of $45,000, of which $30,000 is paid up. Incorporated under the laws of Iowa. The incorporators are W. R. Prewitt, John Douglas, L. C. Sears, F. S. Hartwell, P. K. Holbrook, W. M. Bowles.

Cement Grinding

By L. H. Sturtevant

Increased competition in the cement business is causing the manufacturer to use every endeavor to reduce the cost of manufacture. Naturally one of the first matters to receive his attention is the grinding machinery, as this forms such an important part of a cement plant; in fact, often determines a profit or a loss to the whole business, it deserves most intelligent investigation.

Five important elements enter into the cost of grinding cement materials:

1. Cost of grinding machinery.
2. Power to operate.
3. Wear and tear (up-keep).
4. Production (output).
5. Continuous operation (absence of shut downs).

In other words, the cost of producing finished cement per barrel per hour in the grinding mills covers all of these items, and the cheapest method of producing this result is the aim of every cement manufacturer.

Large units have come to stay, for the cement business is one of large proportions and the use of many small individual machines is becoming obsolete, and rightly so, for who will install ten small grinders when two large ones will do the work?

It is acknowledged by experienced cement engineers that with any of the small machines now in use it requires from 6 to 10 h. p. per hour per barrel to reduce Portland cement clinker to a finish; that the wear and tear is from $800 to $1,800 per year per grinding mill (tube mills excepted).

The above figures are only for clinker. The cost of grinding limestone, coal, shale and clay, while not so great for upkeep, yet the power is practically the same.

Now if a large unit can produce the same results with one-half the power and at one-half the cost for upkeep, one can readily appreciate the reason for its adoption.

The Sturtevant cement unit does all this, and more, for it opens up new possibilities for the cement manufacturer. It not only lessens materially the cost of his finished product, thus making large savings in all of his grinding departments, but lessens labor, cheapens buildings because of the small space occupied for large outputs, simplifies and unifies the entire plant. It insures continuous operation by practically eliminating breakdowns, and by its few and accessible parts the time required for replacement is only a small fraction of that necessary with even the smallest machines.

This illustration consists (see page 5) of a Giant Ring Roll Mill, an elevator, two Newaygo separators and one tube mill.

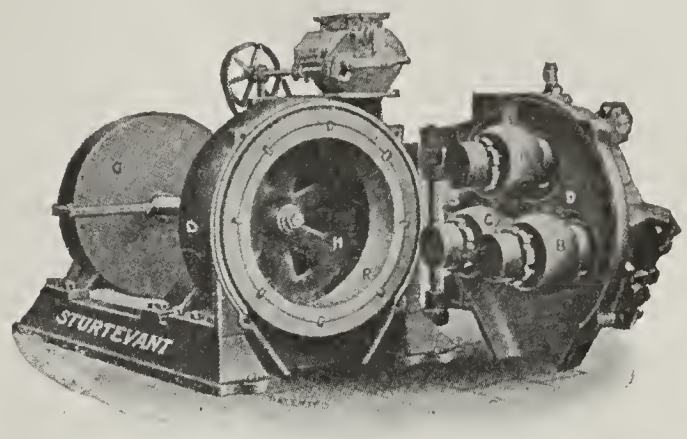
This is a simple, compact arrangement for clinker, limestone or coal, and has enormous capacity.

The Giant ring roll is used in combination with a tube mill for two reasons:

First: Because no single machine can do two kinds of work with equal efficiency; i. e., it is either better as a preliminary grinder than as a finisher, or vice versa.

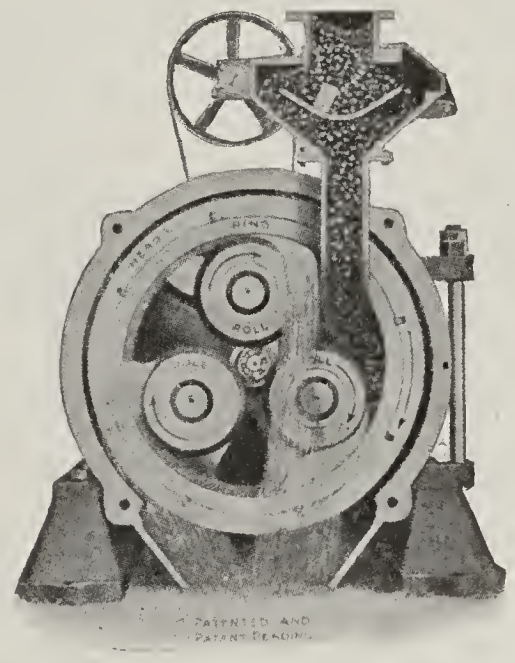
No mill having internal screens can be as efficient as a mill that is free to grind and discharge its finshed product the instant it is made.

It has proved a physical impossibility to make internal screens of sufficient size or give them proper vibration to handle the product of any good grinder. The result is that much of the sufficiently ground material cannot escape, which cushions and thus cripples the grinding action of the machine, lowering its efficiency and causing much useless wear and tear and bearing trouble due to excessive confined dust.



By removing the screens from Ball and other mills, tests have proved the mill efficiency was increased by as much as 33 1/3 per cent.

Again, it is never economical to either screen or air separately a finished product as fine as cement. It is too delicate an operation; it takes too much space and power and it is complicated. Screening coarse material is easy, but with dust of cement fineness it is impracticable on a large scale.



The Ring Roll can finish, and some manufacturers would sell it for such work, but we would rather use it in just the place for which it is best adapted, and if there ever was an ideal preliminary grinder, the Ring Roll is the machine.

On 20-mesh grinding, taking clinker 1½″ size, its output is from 80 to 130 barrels per hour. On 40-mesh work, 60 to 80 barrels. On 80-mesh grinding, 40 to 60 barrels per hour. All of this is accomplished with 80 h. p.

When a preliminary grinder will do such work as that, why try to make it finish or do something that no grinder of its class should be asked to do, and

hamper it with internal screens that hold in material already reduced, and clog and render the grinding members ineffective?

Second: Why do we recommend a tube mill as a finisher when we do not build them and have no interest whatever in tube mills?

Because the tube mill, **properly used,** is just as ideal a finisher as the Ring Roll is as a preparatory grinder.

Properly used the tube mill is a big unit with no small parts to give trouble; and it is a continuous operator.

Even the power is in its favor instead of against it, as most people think. Grinding with a 20-mesh feed it does unquestionably take too much power for its output; i. e., 75 h. p. is needed to drive a 5x22 mill to get from it only 12 to 15 barrels per hour (h. p. per barrel per hour approximately 7 h. p.).

But take that same 75 h. p. and feed the tube with **40-mesh** clinker and note the results: **30 barrels per hour** instead of 12 to 15 barrels as before (h. p. per barrel per hour approximately 2½ h. p.).

Now again, take the same mill, same power, and give it an 80-mesh feed. The results will be a revelation. It now produces from **40 to 55 barrels** per hour (h. p. per barrel per hour approximately 1½ h. p.).

Let us see next what can be expected from a unit, properly arranged, on a scientific basis, where screens are used, but in their proper place, and each machine operated in a highly specialized manner, never allowing either to do anything except **just that work for which its proved adaptability cannot be questioned.**

Plant.

One No. 2 Duplex Ring Roll Mill—
- Taking 1½″ to 2″ clinker and grinding to 80-mesh.
- Capacity, 40 to 60 barrels per hour.
- Power, 80 to 90 h. p.

Two No. 3 Newaygo Screens—
- To take out the 80-mesh material from the Ring Roll product.
- Comparatively coarse screening and 100 sq. ft. of efficiently vibrated 40-mesh wire cloth to do the work.
- Power, 1 h. p. each.

One 6x18 Tube Mill—
- To take the screened 80-mesh ground clinker from the Ring Roll and Newaygo screens and reducing it to a finish, 98% 100- and 85% 200-mesh.
- Capacity, 40 to 60 barrels per hour.
- Power, 75 to 85 h. p.

Thus you see we have a unit of 900 to 1,500 barrels output per day, with a power expenditure of approximately 3½ h. p. per barrel per hour.

This is the largest unit of its type and yet is as accessible and as elastic as any plant of small **individual** machines which is full of complications, and a complete machine shop is necessary to keep it going.

The above Sturtevant unit has been criticised by some men, who have given the matter no thought, on the ground that it is too big, too unwieldy. They say if something goes wrong the whole plant is shut down.

Let us see if this is true.

The Ring Roll mill of duplex design has each half absolutely independent of the other—one half may be operated while the other half is at rest or is stopped for repairs. This feature enables the operator to reduce the workable size of the unit by half.

Again, what is there to get out of order or repair on the Ring Roll? Look it over—you will find no scrapers, pushers, plows, guides, screens, shields, balls or other parts of a nature needing constant renewal as in other mills.

Open the door, a matter of ten minutes, and you will find a large ring or tire and three rolls, and that is all the parts you can find that come in grinding contact with the material being ground.

This explains why there is practically so little wear. Because there are no other parts in these mills that come in contact with any material to cause wear.

Is it likely that the up-keep can be much under these conditions?

You need only to look after the ring and three roll shells. These parts are **thick** and hard and last a long time, because the ring runs at only 64 revolutions per minute and the rolls have exactly the same surface speed, and when they need replacements it is the work of only **minutes** instead of hours to "open the door" and put new rolls on.

Ring Rolls are continuous runners.

Next, you have an elevator and two Newaygo screens to look out for. But you have an elevator in any case, usually **several,** plus conveyor systems that are needed for a multitude of small units; therefore one elevator for a single great producer is not a complication.

Newaygo screens are continuous runners, too, for while the small parts of one screen wear out, yet duplicate parts may be easily and cheaply kept on hand, so there is no delay in the whole system or stoppage while necessary changes are made in one screen.

Bear in mind, this is a comparatively **coarse screening system** and is therefore easy, for the separators have a great capacity on coarse work, and the **large wire** used for coarse screening renders them **durable.**

The Tube mill is the only machine left, and is too well known to require description. You all know its interior parts consist of linings, replaceable once a season, and pebbles which may be replenished at intervals through the manhole. You will agree the Tube mill is a continuous runner.

Shutdowns are expensive for a cement plant particularly that ought to be relied on to operate continuously. This point is appreciated by every manufacturer. The Sturtevant unit is bound to be a continuous runner.

The cost of the Sturtevant unit is less than any other per barrel of production per hour—a whole **lot** cheaper.

The power is less—much less.

The up-keep is many thousands of dollars less, because it requires so few replacements.

Buildings are cheaper, for they may be smaller for a compact unit.

In fact, no feature of this plant can be mentioned that is not better in theory and in practice than any other.

Cement manufacturers are appreciating this fact and are keeping the Sturtevant Mill Co. of Boston, Mass., busy building Ring Roll mills to meet the demand for big, economical grinding units.

ST. LOUIS CORLISS ENGINES.

The new plant of the Lehigh Portland Cement Company at Mason City, Iowa, has been equipped with St. Louis Corliss engines, which are giving very satisfactory results. The St. Louis Iron & Machine Works, St. Louis, Mo., who manufacture the St. Louis Corliss engine have been established since 1865 and have equipped every plant that the Lehigh Portland Cement Company erected with a St. Louis Corliss engine.

Deering Works

New Concrete Manufacturing Building

By W. D. Price, Superintendent of Construction

The year 1911 witnessed more important building construction by the International Harvester Company at its various plants than possibly even the extremely busy season of 1910, the most notable construction work being undoubtedly the erection of a six-story and basement reinforced concrete manufacturing building at the Deering Works.

From the time that reinforced concrete first began to be used in this country as a method of building construction, its progress has been carefully watched by the writer and although reinforced concrete floors were installed by us at the McCormick works ten years ago, a conservative position in reference to its use in important structures has been maintained by B. A. Kennedy, manager of the manufacturing department, until its rapid development and perfection during the past few years have placed it upon a par with other standard forms of modern construction.

Therefore, when it was decided to erect a new manufacturing building at the Deering Works to supersede some of the older structures, concrete was decided upon as the most suitable material from the standpoint of cost, fire protection, lack of vibration, and general adaptability.

The system adopted was a two-way type of flat girder and joint reinforcement, with hollow tile in the panels, making a perfectly flat, smooth ceiling from wall to wall. The ceiling when plastered not only presents a clean, beautiful appearance, but also offers no obstruction to the diffusion of light.

The building is 60 feet wide by 240 feet long, and is six stories and basement in height, and was designed as the first unit of a completed structure, containing five buildings of practically the same size, and is, therefore, arranged to suit the layout of the general plan when completed.

It is no exaggeration to say that the building is the finest example of modern factory construction in this country.

Profiting by the experience of other manufacturers and builders, and by sounding the high seas of modern concrete construction, of lighting, of heating, of ventilation, of sanitary appliances, of elevator equipment, and safety devices, we believe we have pronounced the last word in up-to-date factory buildings.

The width of sixty feet, made up in three bays, with only two rows of columns, is peculiarly adapted for manufacturing work, affording ample light for machinery along both sides with an aisle or trucking space in the center. The interior photograph shows the splendid diffusion of light through the side windows, which extend nearly to the ceiling and are made of steel sash, the small members of which offer but little obstruction to the rays of light and throw no

shadow on the work benches and machine tools. In addition, inserts built into the bottom of the concrete beams as shown on the photograph of the interior, afford a simple and effective support for shaft hangers, piping, and wiring. By means of an ingenious device, designed by the Deering Works, consisting of slotted steel supports spanning the space between the longitudinal inserts, any adjustment or arrangement of shafting or supports that may be desired can be quickly and easily obtained; as John G. Wood graphically expressed it, "We can play checkers with the shafting on these ceilings."

J. E. Merrion, superintendent of the Deering Works, is authority for the statement that saving enough can be effected in the placing of shafting and machinery in this building to pay for the cost of all provision made in the concrete work for supports.

In addition to the advantages to be gained in time and cost by this ease of adjustment, there is the additional advantage of having no shafting timbers, beams, blocks, and supports to obstruct the light, and accumulate dust, both manifestly detrimental to the operation of machineshop work. There is a further decided advantage to be derived in the lack of vibration, causing an unquestionable reduction in the cost of repairs, both to line-shafting and machinery. This has been effectively proven wherever anything in the nature of a direct comparison could be made between concrete and either steel or mill constructed buildings.

It is well known that the management of the International Harvester Company is deeply interested in the question of the proper lighting, heating and ventilation of manufacturing buildings; not only from the standpoint of the comfort and health of the workmen,

out also from the added efficiency to be gained where proper working conditions are maintained. In order to comply with these views, a careful study was made of the problems involved and a system of heating and ventilation adopted which apparently has accomplished the desired object. The system involved the installation of two sets of steam hot blast heating apparatus, located at each end of the basement at diagonal corners of the building. Vento cast iron heaters were used and the fresh hot air from outside driven by centrifugal fans, operated by belted motors through vertical flues and discharged at the ceiling of each room with sufficient velocity to carry the heated air to the center of the room.

Adjustable deflectors were used at the outlets to permit of forcing the air to either side of the room, against the outer walls if found necessary. The foul air is taken from the floor by exhaust flues located in the same stacks as the heating flues, and carried above the

building. These flues are provided with adjustable louvres to be closed at night retaining the heat in the rooms. Each hot air flue is provided with dampers controlled by thermostatic regulators, thus equalizing and adjusting the volume of air delivered to each floor in a positive manner. By this system the air can be changed in the rooms every fifteen minutes; all piping and radiation in the rooms is done away with, saving room, and overcoming the former insanitary features.

In hot weather a constant circulation of cool air can be obtained by running the fans. The system can not be interfered with by workmen.

The toilet and lavatory rooms, equipped along the lines recommended by our Welfare Department, are

also provided with a positive system of ventilation. Ventilating registers back of each fixture open into a closed space connected to a flue leading above the roof. An exhaust fan draws all foul air from the rooms and forces it through the ventilating flue. The toilet rooms are heated by direct radiation, and fresh air is taken through the windows.

Two high-speed electric elevators are used, one at each end of the building. The elevators and concrete stairways are enclosed in fireproof partitions of tile with heavy wire screens between the stairs and elevators, both being well lighted, with all openings equipped with modern automatic fire doors. The elevator gates are operated by a new hydraulic device, very much in advance of the automatic and semi-automatic gates ordinarily used. The gates operate quietly and easily, without strain on the elevator, and only the particular gate to be used can be opened. The gates on two different floors cannot be opened at the same time, and no gate can be opened until all others are closed, making the use of the gates practically "fool-proof."

A test of the concrete floors in conformity with the requirements of the Chicago building ordinances demonstrated the extreme rigidity of the construction, by showing a deflection of only one-sixteenth of an inch under the test load equivalent to twice the safe live load plus the dead load of the floor.

The general contract for this building was placed on May 31, 1911, and from the time the forms were placed ready to pour the concrete for the first floor, July 13, as shown in the photograph, a story was constructed every week and the building was practically completed and occupied by our Deering Works on November 15, 1911.

The rapid progress of the work was attended with the utmost difficulty owing to the limited working space, the structure being completely surrounded by existing buildings.

ASSOCIATION OF WESTERN CEMENT MANUFACTURERS.

Fifteen leading cement manufacturing corporations operating plants between the Rocky Mountains and the Pacific, and representing in capital stock and properties approximately $25,000,000, are to be represented in the Association of Western Portland Cement Manufacturers, formed here yesterday, and to be incorporated under the laws of the state of Washington. The new corporation is a nonprofit sharing company and is formed to promote the interests of the cement industry of the West and to aid in the developing of the good roads propaganda.

John C. Eden, A. F. Coats, F. W. Erlin, F. M. Moose and Dan R. Brown appear as incorporators of the new association. Coats is president of the Washington Portland Cement Company and Mr. Eden is president of the Superior Portland Cement Company. Both of these are Washington corporations. Brown is manager of the Inland Portland Cement Company, whose plant is at Metaline Falls, Wash. Erlin and Moose are California cement manufacturers.

P. W. Rochester, for two years past sales manager for the Washington Portland Cement Company, with offices in the White Building, is secretary and manager of the new association, headquarters of which will be established in San Francisco.

OHIO QUARRYMEN ELECT OFFICERS AND DISCUSS ACCIDENTS BY EXPLOSIVES.

At the closing session of the convention of the Ohio State Stone Club recently held at Toledo, Chairman Moores of the Nominating Committee announced the following ticket:

For President—A. Acton Hall, of Piqua.

For Vice-President—Morris P. Goetschious, Lima.

Secretary-Treasurer—H. W. Hawblitz, of Toledo.

Executive Committee—George B. Christian, Sr., Allan Patterson and F. Lawson Moores.

On motion of Mr. Quilter, and seconded by Mr. McKee, the report was adopted and the secretary instructed to cast one ballot for an expression of the vote of the convention.

Colonel Christian announced that the hour had come when the associate members and material men present should have an opportunity to talk to the convention.

Madison Whitesides, of the Aetna Powder Company, was called on to talk on the subject of "Explosives" after Colonel Geo. B. Christian, president (Marion, O.) had referred to the number of quarry accidents which have occurred in Ohio recently.

Mr. Whitesides said: "Explosives are frequently handled carelessly in spite of all that we are constantly saying and doing to caution them in every way that we know how. I find men gathering in the thaw house to eat their lunch, and in cold weather I have frequently seen red hot stoves in the thaw house and the stove entirely surrounded by dynamite in boxes and in exposed sticks. It is a matter of fact that powder salesmen find that unsolicited advice and caution of these matters is not always received kindly, and unless asked he will seldom go into the feature at all. It is true that scarcely a quarry accident occurs which could not have been avoided if somebody had only been careful of the very things which the powder manufacturers had cautioned them against time and again. I am certain that my company will be pleased to send plans so that any one can build a standard thaw house that will be safer than any other. At present the thawing proposition is indispensable with the class of explosives that have to be used in quarry operations."

Mr. Quilter: "I thaw dynamite with manure. I tried various powders, but could get better results by burying the box of dynamite in the manure pile."

Mr. Whitesides: "In all such cases dampness must be avoided. Damp places make a very dangerous condition for dynamite."

Mr. Bird: "I am afraid of dynamite. We had a steam arrangement at first, and I kept from three to five hundred pounds of powder there. I do not like thaw houses as a rule, and I have found that burying the box has given us fairly good results."

George B. Christian, Jr.: "How many of the members have noticed what the workmen's views are on the employers' liability?"

Colonel Christian: "As a matter of fact, we handle our dynamite very cautiously, as a general rule, in the quarrying business. I consider the farming business as the most hazardous business in the world. The vicious bull, the runaway horse and the many other accidents of farm life kill more people annually than are injured in quarries by dynamite. When it comes to the employers' liability proposition, it looks like the best way to get along is to be so very poor that nobody will expect you to pay anything."

Use of Dynamite.

Mr. Dennison, of the Dupont Powder Company, was next called on, and he remarked that dynamite is safer now than it was some years ago. He is always prepared for such occasions and had written up a brief memorandum of points to be observed in the use and handling of dynamite, which were well received.

Referring to the drill hole, Colonel Christian said:

"We are using 25 holes and putting them down with well drillers. I consider the big hole shot just as much safer as the number of holes is dangerous. Each blast hole is a distinct risk and by using big ones and fewer of them we get less risk and the same or greater results. The trouble with using explosives is that familiarity often breeds contempt. I consider the fearless man about the handling of dynamite is just simply a fool. I have always been afraid of it and always will be."

Mr. Patterson: "I have been the hole blast man of our concern for years. I have personally conducted the shot myself for a long time and my opinion as an expert is that you cannot be too careful."

SAND AND GRAVEL COMPANY.

The C. H. Little Company, Detroit, Mich., which recently took over the sand and gravel business of Byron S. Aldrich, has purchased the sand and gravel business of John M. McKerchey. The deal includes the steel steamer John M. McKerchey and the wooden steamer Pine Lake. The recent purchases by the C. H. Little Company give that concern a fleet of four modern sand boats with the largest capacity of any sand fleet on the great lakes. The McKerchey was the first steel sand steamer ever constructed on the lakes. She is considered the best equipped vessel of her kind. The other vessels are the Pine Lake, Sachem and C. H. Little. Mr. McKerchey has been appointed superintendent of the fleet.

The C. H. Little Co. controls sand and gravel beds at Point Pelee, Pelee island and Fish Point, Lake Erie, and in the middle and north channels of St. Clair river.

NEW CRUSHED MARBLE PLANT.

At Tuckahoe, N. Y., the Marbolith Stone Co. has just completed its third modern crushing plant for the production of crushed marble in sizes ranging from impalpable dust to the coarsest screenings. This material is crushed from Tuckahoe marble and is much in demand for use in concrete work.

In stucco mixtures, crushed marble gives a pure white glistening appearance that is very popular. In the manufacture of concrete block, steps, sills, lintels and ornamental pieces white crushed marble is valuable for facing.

Fujiwara & Co., Tokio, Japan, have placed an order with the Automatic Sash Holder Co., 275 Broadway, New York City, for 1,100 sets of sash holders. This Japanese company has erected the only building in Japan built entirely with American materials.

CONCRETE ORNAMENTAL POSTS.

A new venture in municipal lighting is being made by Venice, Cal., with a concrete ornamental post, designed by City Engineer Lewis. The city will manufacture them to sell to property owners at cost and furnish light free of direct charge. Molds made to order have been procured by the city and all preparations for producing the standards in municipal yards are complete. The post itself will cost $9. The total expense of setting up the concrete post, equipping it with electric light and connecting with conduit is placed at $15 each.

The "Standard" Low Charging Mixer With "Cart Charger"

Designed for rapid work and to do away with the use of wheelbarrows for bringing the materials from the piles to the mixer. Several carts, each having capacity of one batch for the mixer, are used and are taken to the piles, and the proper proportions for one batch of stone or gravel, sand and cement are placed in the carts. By using the hoist at the mixer with a rope or cable for attaching to the carts, they are brought on to the mixer platform, where the complete batch is dumped into the mixer as soon as the previous batch is discharged. The cart is then taken back by the man who guides it to the mixer and the rope removed from the empty cart and attached to another loaded cart and the process is repeated.

By using several carts the workmen shoveling or filling them can always load the empties and have several batches ready if there is a few moments delay at the mixer, for moving or for any reason.

The complete batch, including the gravel or stone, sand and cement are placed in the carts on the ground level and the whole batch pulled from the material piles onto the mixer platform by the power that oper-

ates the mixer, and is ready to be charged into mixer as soon as the previous batch is discharged from the drum. With the carts there is no clogging and no necessity for pounding on the bottom, or using other methods to make the discharge clear, as is so necessary on charging hoppers and side loaders.

The man operating the engine on gasoline outfits also operates the hoist, and the automatic water tank, and it is not necessary to have a man on the mixer platform, consequently one workman less is required at the mixer.

We also claim that with this outfit from one to three less workmen will be necessary for bringing the materials to the mixer and that a greater amount of work will be accomplished with the few men required.

It will be seen by this that the saving of labor cost alone will pay for the complete outfit in a very short time.

After rains and in wet weather when the runways are slippery, or during extreme hot weather, the "cart charger" will bring the materials to the mixer just as easy and rapidly without over exertion of the men.

Also when the materials are wet they can be handled in this "cart charger" and readily dumped into the mixer, when it would be impracticable with side-loading hoppers or other methods. Contractors who have used side-loaders will appreciate that wet materials will not slide from the charging hopper into the drum.

The mouth of the carts being as wide as any other portion, and as they can be tilted completely, allows the material to fall very easily, and complete batch is charged from the carts into the large opening of the mixer drum in about five seconds. As it requires from three to six times this long by any other method, you can readily see that the batch will be mixed and ready to discharge by the time it would be placed in the drum.

When using the "cart charger" the mixer can be raised above the street level if desired, so as to give a down grade for handling of the mixed concrete from the mixer to the forms, and the mixed concrete can then be handled in carts down a slight incline easily and quickly.

On street or other work where the mixer is moved forward as the work progresses, the cable which is used to draw the carts to the mixer can be attached to some stationary object ahead, such as a telegraph pole, and the mixer pulled forward on the job by the use of its own power.

For street intersection work a specially rapid discharge arrangement is used, so that the batch is discharged in two or three revolutions into carts which are generally used to take it away.

The hoist used for drawing the carts to the mixer platform can be used for regular hoisting work if desired. In other words the hoist on this outfit can be used for hoisting material or equipment on the building, when customer is not using the mixer for concrete.

Both the mixer and the hoist are operated independently and either can be thrown out, while the other is being operated.

Our new catalog, No. 80, gives more information on this, as well as other money saving designs of the "Standard" mixer. Write for it today. Standard Scale & Supply Co., 1350 Wabash avenue, Chicago, Ill.

DUST COLLECTOR AT HUDSON, N. Y., CEMENT MILL.

Mayor Louis Van Hoesen, City Engineer Michael J. O'Hara and a number of other city officials of Hudson, N. Y., visited the Greenport plant of the New York and New England Cement & Lime Company, Thursday, and inspected the new dust collecting machine which has been installed there. The new device is used to catch the dust and keep it from escaping through the stacks. The one which is now in use has proved most successful and two more will very shortly be installed, one for each of the other two stacks.

The machine has been installed under a kiln building, operated by electricity, and connected with the stack by an opening. The device is similar to a huge fan which draws the dust from the stack as it is about to go to the top, and deposits it in a bin at the end of a pipe conveyor. The dust collector is said to be the most practical and successful one ever invented, says the Hudson, N. Y., Republican.

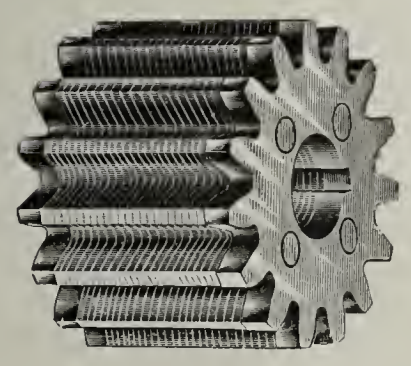
In order to show the city officials the efficacy of this machine, both kilns were fired, the steam, smoke and dust each going into a separate stack. In one stack the collector was in operation while in the other there was none. Only a light vapor-like smoke escaped from the former stack while a heavy yellowish-black smoke could be seen pouring from the other. The officials of the local plant are highly elated over the manner in which the new device performs its work.

THE RAWHIDE PINION.

The idea of constructing a gear of rawhide was first conceived by the late Captain D. R. McCutcheon, who was at the time connected with the Chicago Rawhide Manufacturing Company, 1301 Elston avenue, Chicago. The rawhide pinion was made to replace one of metal in a gear drive that was giving a customer considerable annoyance on account of noise. The noise was practically eliminated and it was demonstrated that rawhide had as much strength and gave wear equal to that of metal used in the same place.

Rawhide pinions did not come into general use, however, until the coming of direct drives with electrical power. Rawhide being a non-conductor was found to be a safe material for use around electrical machinery. It was also demonstrated that there was sufficient flexibility in rawhide to relieve the machine of vibration, thereby doing away with the jar, prolonging the life of the machinery and making a great saving in the cost of repairs and materials.

The efficiency of a rawhide pinion depends primarily upon the fibrous strength of the hide from which it is made. Great care should therefore be exercised in the selection of the rawhide blank for pinion purposes.



The Chicago Rawhide Manufacturing Company has specialized rawhide for mechanical purposes since the organization of the company in 1879. Its rawhide has been standard for over thirty years. The popularity of its rawhide pinions is attested by the fact that from a work bench and hand tools used in making the original pinion the factory has expanded into one of the largest and most completely equipped gear shops in the United States.

The old plant of the company was entirely destroyed by fire in January, 1910, consequently the reconstructed plant is equipped throughout with the most modern and up-to-date machinery. The equipment is such that metal as well as rawhide gears and pinions can be handled.

UNUSUAL COMBINATION OF REINFORCED CONCRETE AND CONCRETE BLOCKS.

The E. E. Woodward building at Rockford, Ill., is particularly notable in that the construction is a combination of reinforced concrete and concrete blocks. The entire frame, including columns, floors and stairways, is of reinforced concrete, while the walls and partitions are constructed of concrete blocks. No wood is used except for the window frames. It is interesting to note that the blocks carry none of the load of the building and contents except their own weight. The building is 143 by 70 feet, five stories high with basement. The concrete used was proportioned 1:2½:4 and was entirely mixed by a batch mixer. The Simpson Construction Co. of Chicago were the contractors for the concrete work, while the building was designed by Francis M. Barton of the same city.

THE CONCRETE BURIAL VAULT INDUSTRY.

The statement is made that there has been a wonderful increase in the use of concrete burial vaults during the last few years and that a greater development in the concrete burial vault industry will be witnessed in the near future than has been the case in the past. One reason assigned for this is that the public generally is being educated out of the old time method of burying the dead with only an ordinary wooden coffin and along with this education has come a spirit of investigation on the part of the people as to what kind of burial vault is best, this resulting in an ever increasing demand for concrete burial vaults.

The Automatic Sealing Vault Co. of Peru, Ind., appreciating this condition has spared neither time nor money in bringing their Automatic Sealing Vault up to a high state of perfection.

The Automatic Sealing Vault is said to be constructed on a plan entirely different from any other concrete vault, as no cementing of any description is necessary to exclude the water. The Automatic Seal is obtained by simply placing the cover in position on the body of the vault, which extends up into the cover in such a manner that when the water in the grave rises to a certain height the air is sealed within the vault, completely excluding all water.

It is also stated that while the Automatic Sealing Vault has been on the market less than three years they are being sold today by hundreds of undertakers in more than one-third of the states of the Union, and have made their way into foreign countries, where they are giving universal satisfaction.

This company manufactures adjustable steel molds for the molding of their Automatic Sealing Vault which are made of Bessemer sheet steel, each section being made from a single sheet of metal, the manner in which the metal is bent giving the proper shape and making the molds extremely rigid. Where extra strength is required the sections are reinforced with angle braces secured in such a manner that all surfaces coming in contact with the cement are free from rivet heads and all other irregularities.

Anyone interested in the manufacture of burial vaults should write the company for their handsomely illustrated new catalog, which contains full information as to the construction of the molds, their product and advantages. Copy will be sent readers of Cement and Engineering News free upon request.

SOAP CONCRETE SUCCESSFULLY USED.

Soap-water instead of ordinary water has successfully been used for the purpose of making reinforced concrete water tight. The case is reported in Beton und Eisen, and concerns a grain elevator built on the Danube, exposed to inundation. The concrete was provided with two coatings, also of concrete. The outer coating, 3½ inches in thickness, consists of fine-grained concrete containing 400 kg. of cement and 120 litres of water per cubic metre of mass, and the inner layer, ½ inch in thickness, consists of cement mortar prepared with fine river sand. The water is replaced by a solution of common soft soap (potash soap), about 4 kg. of soap being added to 1 cubic inch of concrete. The building has stood one inundation well, while another building of the same material, without the soap, did not quite keep the water out. Subsequent tests were also favorable. The soap concrete is very cheap compared with other means used to render the concrete impermeable to water. The action of the soap seems to be that the lime of the cement is bound by the fatty acids of the soap.

ADVERTISING—A PRODUCING PART OF THE SALES FORCE.

By M. R. D. Owings.*

Modern business is based wholly on good will. It can live as long without good will as a fish can live out of water. There is so much business, so much competition, such facilities for getting everything, that the slightest ignorance or the most whimsical prejudice may turn away many customers and their dollars and cents. This fundamental truth makes advertising not only possible but very vital. Unfortunately the exact productiveness of advertising cannot be measured in dollars and inches. But to say that it is non-productive would be folly. It would be flying in the face of the experience of all successful business concerns. All progressive houses and companies advertise. The most progressive of them advertise the most. The most successful advertise not only widely but wisely. They have learned the great power of education, suggestion and art. In other words they have learned the incalculable value of good will.

Now-a-days there is nothing quite so vitalizing to any institution or corporation as the personal, the human touch. The advertising department is or should be the personal side of every corporation. It is there that those subtle forces are generated which create good will. In the form of courtesy, personal interest, mutual help, and eagerness to supply just what is wanted, these forces go out over the country and work without ceasing night and day. The results that they bring are constant and cumulative. If people know just what you have, if you have convinced them that it is good and if they are personally friendly they will buy from you. Judicious advertising makes every customer an agent. But even where agents do not go, advertising goes noiselessly and effectively. The months when the weather prevents traveling, when activity is slack with the salesman, advertising goes to prepare the way. In the quiet of these indoor months, it shapes habits of thought. The action born of these thoughts will naturally follow the trails blazed by advertising. Where will these trails lead?

Money spent in advertising is bread cast upon the waters. It often may seem like the voice in a wilderness, but in the distance of time its echoes are redoubled and become far-reaching.

No one ever questions the value of good music. Although its effects cannot be measured we know that it elevates and refines through the emotions. Advertising is the emotional side of business. It not only makes business more successful, but it lifts it out of the ordinary into the unusual, out of the commonplace into the interesting, extraordinary and attractive.

*Advertising Manager, International Harvester Company.

CRUSHED STONE COMPANY.

Thornton Dixon, president of the Shore Line Stone Company of Monroe, Mich., and sales agent for the Sibley Quarries near Trenton, Mich., operated by the Solvay Process Company of Detroit, has concluded a contract to handle the product of the quarries of the Monroe Stone Company, operated by the France Company of Toledo, also the product of the France Slag Company of Detroit, all used for paving and road-making. The combined output will be about half a million tons per year. The offices of the concern will be in the First National Bank Building, Monroe, Mich.

VALVES AND ENGINEERING SPECIALTIES CATALOG.

The Lunkenheimer Company, Cincinnati, Ohio, largest manufacturers of high grade engineering specialties in the world, advise us that they have just issued their new 1912 catalog. The book is just off the press and contains 654 pages, being 100 more pages than that of their previous catalog.

The new book contains a large number of new goods and the whole is undoubtedly the largest line of high grade engineering specialties in the world.

The book also contains a large quantity of useful information and data particularly of great value to engineers.

A copy will gladly be furnished anyone interested, free of charge.

METAL PROTECTED BY CONCRETE.

The experiment being conducted by the Baltimore & Ohio Railroad at Columbus, O., of protecting metal structures by a covering of concrete, is interesting local maintenance-of-way and engineering officials. The experiment was induced by the large expense entailed in protecting the metal by repeated painting. The Baltimore & Ohio recently treated five plate girder spans of 80 to 90 feet with concrete. In preparation for the work the rust was removed. After the metal was cleaned, wire cloth was wrapped over the top and bottom flanges and around the columns. The forms were built around the girders in such a way as to give a thickness of concrete of six inches on all sides. Similar work has been done by the railroad in Cleveland, O., and more will be undertaken shortly at the Chicago (Ill.) terminal.

CONCRETE SILO FORMS.

A new system of Circular Monolithic Construction that is attracting widespread interest and attention is fully illustrated and described in an attractive booklet just issued by the originators and manufacturers, Polk-Genung-Polk Co., Inc., Fort Branch, Ind. The views presented show complete or incomplete work as well as the operation of this company's machines. The photographs have not been retouched and show conditions as they actually exist. This booklet should appeal especially to the wide awake and progressive farmer, giving him information of a modern and economical method of constructing silos, a necessary adjunct of the up-to-date farm. Copy will be sent readers of Cement & Engineering News.

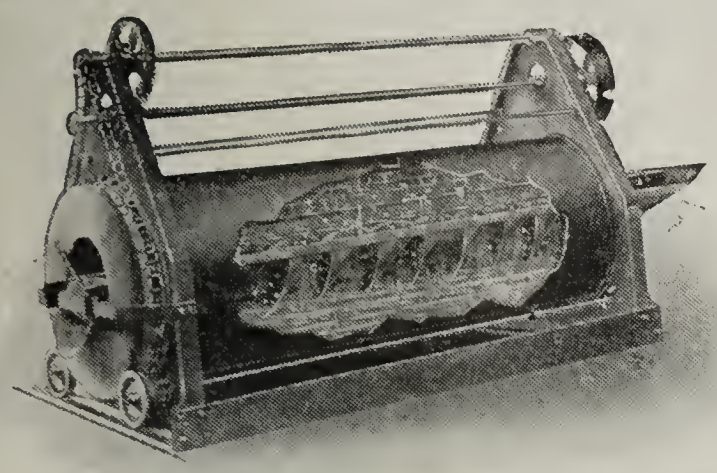
CRUSHED STONE NEWS.

Lenni Quarry Company of Philadelphia, Pa., recently incorporated to do a general quarrying business. Capital, $25,000. Treasurer, J. W. Steigleman, 1211 Locust Street, Philadelphia.

Jackson Stone and Sand Company of Mercer, Pa., recently incorporated to quarry and deal in stone, sand, etc. Capital, $10,000. Incorporators: W. G. Christley, F. E. Filer and J. M. Campbell, Mercer, and W. H. Harrison, Leesburg, Pa.

The Wagner Quarries Company of Sandusky, Ohio, recently incorporated to conduct a general quarrying business. Capital, $500,000. Incorporators: Michael, Alexander M., A. E. and Clarence E. Wagner, and William Hendrickson.

Good Concrete Work Demands Good Materials



Don't Use Dirty Sand, Gravel or Crushed Rock. Turn Out a First-Class Job by Using the

Stocker Concrete Material Washer

The machine which is guaranteed to remove all impurities which are soluble in or which will float on water.

Various Sizes Made to Suit Requirements

FOR PRICES AND ALL OTHER PARTICULARS, WRITE TO

Stocker Concrete Material Washer Co.
HIGHLAND, ILLINOIS

What One Contractor Accomplished with

Hotchkiss Steel Curb and Gutter Forms

Lineal feet built, 9983. Time, 200 hours. Labor force, 16 men. Forms used, 160 ft. **Labor Cost, 8.3 cents per lineal foot.** Users of wooden or any other forms, match it if you can! Write for free booklets.

Hotchkiss Lock Metal Form Co.
Dept. O. Binghamton, N. Y

ALPHA PORTLAND CEMENT

The Recognized Standard American Brand

Quality Unexcelled Always Uniform

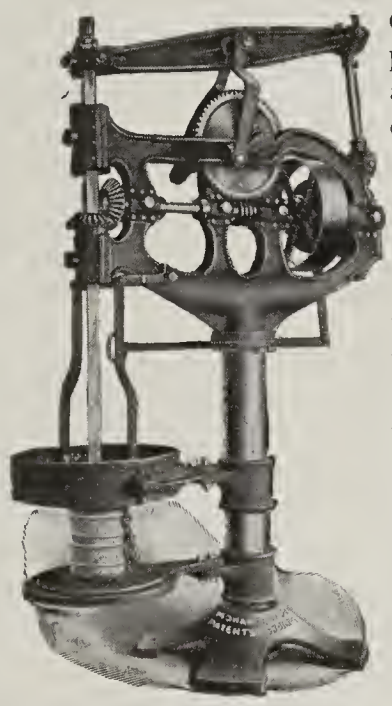
Annual Output 6,500,000 Barrels

Alpha Portland Cement Company
General Office, EASTON, PA.

Chicago Office
Marquette Bldg.

Works at Alpha, N. J., Martins Creek, Pa.
Manheim, W. Va., and Alsens, N. Y.

No Tile Manufacturer



(**Monarchs Shipped on Trial.**)

can afford to ignore the improvements made in **Jackets and Jacket Fronts, Packer Heads, Pallets** and other

IMPROVED EQUIPMENT

we have on the market. Send us an order for a trial outfit in any size you want to make, from 4 inches to 18 inches in diameter. Our supplies will increase the earning capacity of your machine.

We have a full line of Cement working machines and can equip your plant with any machinery you want.

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NEW CEMENT RATE HELPS MICHIGAN FACTORIES.

The nine cement manufacturing companies of Michigan whose annual output is about 4,000,000 barrels, are very much pleased over a new tariff rate on eastern made cement, which becomes operative March 25. The new rate will be worth about 3 cents a barrel to the Michigan manufacturers, or approximately $120,000 a year. The interstate commerce commission approves the new rate, and the Michigan state railroad commission will also officially sanction it.

The new rate will remove the discrimination in favor of Lehigh Valley and other eastern made cements which, it is asserted, has existed for some years. This discrimination, cement men say, was the main cause of putting four Michigan cement companies out of business in the past three years. For a little more than three years a contest has been on in the courts, the interstate commerce commission and the state railroad commission, between the cement manufacturers and the railroads over freight rates. This contest now ends. The circumstances are these:

On Feb. 24, 1909, the railroads undertook to raise the rate on cement from the Michigan factories to Detroit from 63 per cent of the sixth class to 73 per cent, the rate to other Michigan points to be pro rated on the Detroit rate. This would have meant an average raise of 2 cents a barrel on the 4,000,000 barrels produced annually in Michigan by the nine companies, which are: Wolverine, of Coldwater; Omega, of Coldwater; Etna, of Fenton; Huron, of Alpena and Detroit; Peerless, of Union City; Peninsula, of Jackson; Michigan, of Chelsea; Burt, of Bellevue, and Newaygo, of Newaygo.

On the same day, Feb. 24, the Michigan cement manufacturers secured an injunction from Judge Swan of the United States court at Detroit, restraining the railroads from putting the proposed raise into effect. This injunction remained in force until April, 1910, when it was dissolved. In July, 1910, the cement companies filed complaints with the interstate commerce commission, and also with the Michigan railroad commission.

In the meanwhile—the time being in the summer of 1911—some of the Michigan railroads lowered their rates for cement from the factories to Detroit from a 5 cents a barrel basis to 4 to Detroit, and to other state points pro rata. This reduced rate was continued for but a few months when the companies gave notice that they were going back to the 5-cent rate. The interstate commerce commission, whose jurisdiction is restricted to interstate traffic, and the state railroad commission, the jurisdiction of which is restricted to interstate traffic, issued restraining orders forbidding the companies reviving the five cents a barrel tariff.

The issue was threshed out before both commissions. Last month the interstate commission gave its decision, which was that the railroads could restore the 5-cent-a-barrel rate for Michigan factories, provided they raised the Lehigh Valley and eastern rates so that cement from those sections could not be delivered in Detroit and other Michigan points and sold at a figure below what Michigan factories can sell at and make a reasonable profit.

The railroads, acting under this decision, raised the rate on all eastern cement to 80 per cent of the sixth class. That is what the new tariff, operative March 25, provides. As adjusted, the Michigan factories will be in better shape than at any time since the manufacture of cement began in this state to get a reasonable profit on its products. From the beginning Michigan manufacturers have had to meet the eastern prices, which they sometimes could not do and make a reasonable profit on investment. The price of cement in Detroit has been, say 50 cents Lehigh Valley, plus the freight.—Michigan Manufacturer.

CONCRETE FENCE POSTS.

One branch of the concrete industry which has shown great advancement in the past few years, and which promises to become one of the most important branches, is the manufacturing of concrete fence posts.

When concrete in general first sprang into popularity, some experiments were made with concrete fence posts. A few failures were reported, which, after investigation, proved to be the fault of mixing the concrete. A dry tamped mixture was used and after a thaw, followed by freezing weather, it was found that the concrete split. The Department of Agriculture gave this a great deal of attention, and, after further tests at their Colorado Experimental Station, issued a bulletin showing that concrete fence posts made of wet mixture overcame this difficulty.

Posts of this type have been used on farms for the last six and seven years, and are found to be stronger and more durable than when first set out. Wooden posts are advancing in price each year from two to three cents, while the quality of the posts, owing to the dearth of our old forests, is far inferior to that found a few years ago. The concrete posts can really be considered an improvement on a farm, as they are far more sightly and give far less bother than the wooden post.

The railroads of this country spend millions of dollars each year in replacing rotted and burned fence posts along their right-of-ways. As this item of expense is one of the largest in the maintenance of way department, a great deal of attention has been paid to the concrete post.

Not long ago, one of the leading railroads, with over 3,000 miles of trackage, conducted a series of tests on concrete posts made with molds manufactured by the Ohio Post Mold Company, 220 Nicholas street, Toledo, Ohio, and also with molds made by the Northwestern Steel & Iron Works, 1080 Spring street, Eau Claire, Wis. Posts were placed in the ground 16 feet apart and a panel of woven wire stretched between; a 200 lb. bag of sand was then swung pendulum-wise against the panel. It was impossible to destroy the efficiency of the fence in this manner, and it was also impossible to break down the post, except by applying the bag of sand repeatedly against the face of the post. This was a very severe test, as conditions of this kind are not encountered on the ordinary farm with ordinary domestic stock.

The railroads from coast to coast are fast replacing their wooden posts with those of concrete, and it will be but a matter of a few years before travelers will enjoy the view of a straight, uniform fence along the right-of-ways, instead of unsightly, distorted wooden posts of all sizes, many charred at the base by grass fires.

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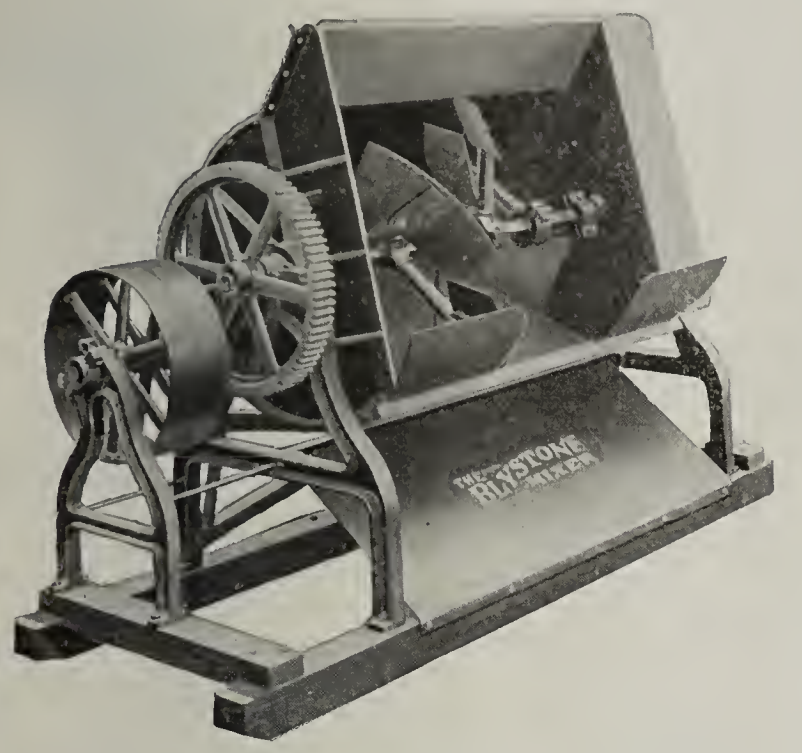

Where the highest grade of cement work is produced and uniform accuracy is required. We have the best, cheapest and most economical shop mixer on the market. It is ready to belt to engine or motor. Can be located at any point in the shop. Also is mounted on hand trucks for combination shop and outside work, or mounted on horse drawn trucks with power. We can save you money and annoyance and enable you to turn out better product. Write for full information.

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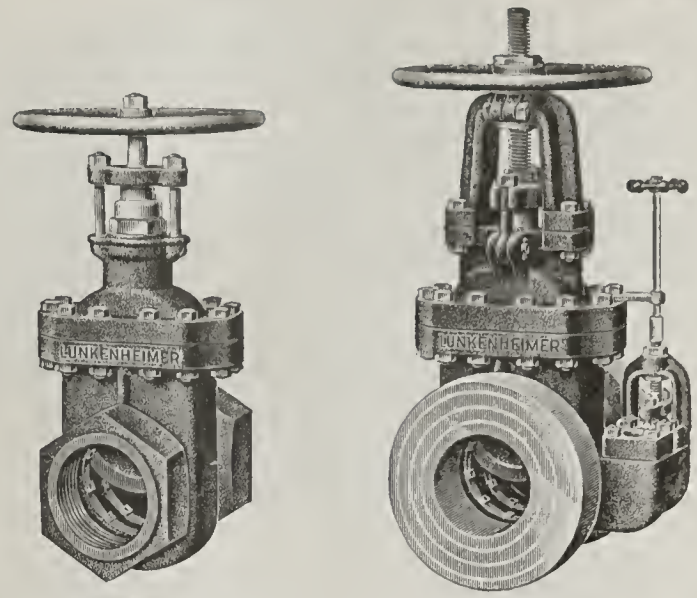

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Made in Standard, Medium, Heavy and Extra Heavy Iron Body, Brass Mounted Patterns, "Puddled" Semi-steel and Cast Steel, with either Stationary Stem or Outside Screw and Yoke, and with or without By-pass.

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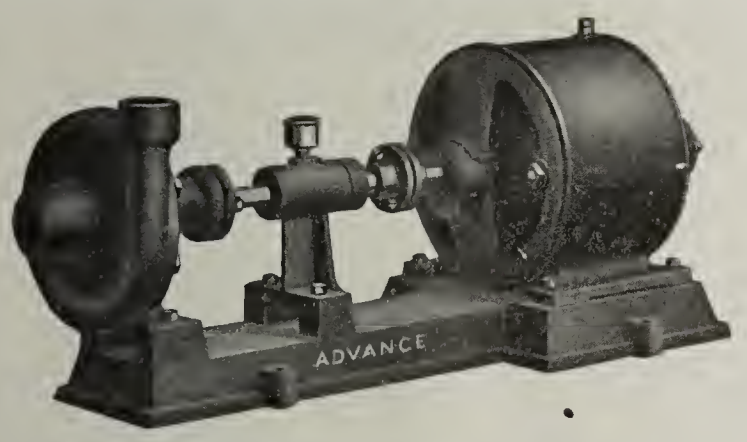

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Advance Pump & Compressor Co.
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To Insure Complete Detonation of Explosives

Detonating a series of charges electrically not only results in deriving the full benefit from the explosives, but it is also a safer, quicker and easier method.

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Send for Blasting Supplies Catalog No. 112, giving complete description of Du Pont Blasting Machines and Blasting Supplies.

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CONCRETE ROADWAYS.

Concrete roads have been the principal type of road built by Wayne county, Michigan, and concrete roads are the accepted standard of construction. The road commissioners state that their aim is to provide the county with durable, permanent roads. They believe that the concrete road that they devised and built has accomplished their purpose, and that that type of road is the coming roadway. It is a road that is low in ultimate cost, pleasing to the eye, smooth, dustless, and affords excellent traction for all types of vehicles. While their early efforts at concrete road building were somewhat experimental they have devised several means in their methods of construction which will add materially to the life of concrete roads. Among the more important improvements have been:

(1) The increase of the amount of cement used in the mix, changing from 1-2-4 mix to 1-1½-3 mix;

(2) More stringent specifications as to quality of stone and sand;

(3) An increase in the depth of the work to not less than 7 inches;

(4) A protecting plate at the expansion joint.

The Eureka road in Wayne county is a typical example of the type of roads built. Eureka road is one of the principal roads leading into Wyandotte. It is built of concrete of a 1-2-4 mix with 12 feet of metal, 23 feet over all at its narrowest point. It was built last fall, and additional mileage will be constructed at an early date.

The following is a statement of the expenditures on Eureka road, a stretch one mile in length, up to and including September 30, 1911:

Roadway Proper.

	Cost	
Teams	$ 980.00	
Other labor	3,364.15	
Pebbles, tons 2,014	1,657.78	
Sand, tons 700	684.94	
Cement, barrels 1,218	1,723.97	
Coal, tons 60.75	189.45	
Expansion joints	77.60	
Lumber and engineers stakes	14.31	
Water supply	110.14	
Blue prints, advertising photos	11.47	
Lubrication, waste, etc	48.51	
Liability insurance	49.41	
Hardware and repairs	27.50	
Express, messenger and auto	53.03	
Miscellaneous	48.81	
		$9,041.07

Drainage.

Open ditch	$ 265.01	
Tile drains	48.84	
		313.85
Total cost of roadway proper with drainage		$9,354.92

HIGH GRADE CENTRIFUGAL PUMPS.

Catalog K-31 of the Advance Pump & Compressor Co., Battle Creek, Mich., is just off the press and a copy is being mailed to all those interested in high grade centrifugal pumps, belted or electric drives, horizontal, vertical or multi stage pumps; engine driven direct connected. It also presents in a brief and compact form the several types of duplex steam, power, tank, vacuum, low duty and high pressure pumping machinery which are being manufactured by this company.

The Advance Pump & Compressor Company is expanding its line of products and the company's plant is reported to be operating to full capacity in all departments. Send for the new catalog.

ANTI-STICK PRODUCTS.

Anti-Stick products, made by the Anti-Stick Company, Westerville, Ohio, have back of them a number of years of experience in concrete work, and all of them will be found of much value to workers in this line. Anti-Stick is a liquid coating for concrete forms, to prevent the concrete from sticking. It can be used on steel, wood, glass, gelatin, or plaster of paris forms, and will also release concrete from concrete, and concrete from natural stone. This is used only for slush concrete. Another product, known as Anti-Stick Enamel, is used on forms which are removed immediately after molding. For waterproofing, the company supplies Anti-Damp, a liquid which can be had in several colors; and for floor finish there is said to be nothing better than Elephant-Tread. Write to the company for particulars regarding any or all of these products.

HYDRATED LIME PLANT.

Over one hundred stockholders of the Potomac Refining Company, among whom are some of the most prominent business men of the South, were present at the opening of the company's new hydrated lime plant near Harper's Ferry, W. Va., recently. The plant cost $100,000 and has a capacity of about 120 tons of hydrated lime a day. The officers of the company are: M. P. Kehoe, president; Louis F. Plack, vice-president; E. R. Cooper, general manager; H. C. Hess, treasurer, and C. B. Sanger, secretary.

BUSY PETOSKEY QUARRIES.

The Petoskey Crushed Stone Company has been obliged to procure additional facilities for handling the output of the quarry. At present the company is working about seventy-five men in the quarry, all of whom are receiving good wages. Additional men will be put to work as fast as the business warrants it. At present about 1,200 tons of stone per day are being crushed. The greater part of the output is shipped to Mayville, Wis., and Newaygo, Mich. In all, some thirty cars of stone are shipped out of Petoskey daily.

The American Centrifugal Concrete Co. has been incorporated at Yuma, Ariz., by P. Max Kuehnrich, Louis Blackenhorn and Lawrence Macumber, with $100,000 capital stock. Yuma is the company's headquarters.

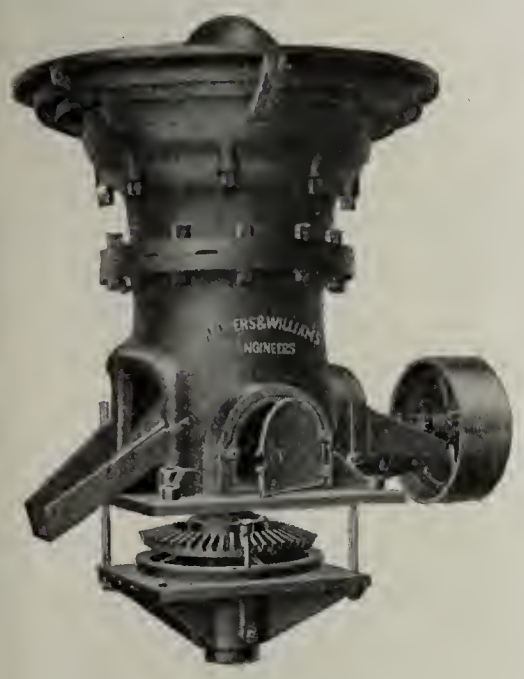
Henry N. Hooper, 517 Provident Bank Bldg., Cincinnati, Ohio, advises us that he is preparing plans for a seven-story reinforced concrete warehouse, to be built at Sixth and Eggleston avenues, for the Whitaker Paper Company.

Varney & Varney, architects, 318 Palmer Bldg., Detroit, are preparing plans for a one-story factory for the Detroit Concrete Receptacle Co. The cost will be about $20,500.

Calwa, Cal.—The Atchison, Topeka & Santa Fe Ry. has awarded the contract to the Sharp & Fellows Contracting Co., Los Angeles, for a reinforced concrete roundhouse at Calwa Riverbank.

Los Angeles, Cal.—The contract has been awarded to C. A. Fellows, Central Bldg., Los Angeles, for building a reinforced concrete roundhouse for the Santa Fe Ry. Co. The cost will be $65,000.

You Can Buy a Gyratory Crusher for Less than You Think



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Basement Waterproofed with Ceresit.

Ceresitized Concrete and Cement Mortar are Permanently Waterproof

and possess the highest efficiency at the lowest cost of any known method of waterproofing. Ceresit is a cream white paste which is incorporated in the concrete mass of cement mortar. It is put into the water used in mixing the ingredients before the mixing is done. The water carries the Ceresit into every portion of the mass uniformly—thoroughly and renders it absolutely water tight when in the structure.

"Ceresit" Waterproofing

is guaranteed to be an absolutely unfailing water repellant and thus protects concrete structures from disintegration and damage from frosts.

Ceresit makes concrete denser; does not alter its color and does not lessen the tensile strength of the concrete.

There is no known method of waterproofing, regardless of cost, that is more efficient on important concrete engineering, such as tunnels, foundations, sewers, bridges, reservoirs, dams, tanks, swimming pools, water-towers and tanks, floors, cellars, walls and roofs.

Ceresit is also applicable for use in cement mortar and will damp-proof and water-proof structures built of concrete, brick, stone or tile. It is also used in cement mortar coatings on stucco and cement plaster surfaces.

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(12)

PLEASE CUT OUT THIS

REMINDER

to write Ceresit Waterproofing Co., Clark and Adams Streets, Chicago, for Book "Q" on Waterproofing Concrete and Cement Mortar.

NEWS ITEMS.

The American Concrete Tile Company has been incorporated with a capital of $5,000 at Oklahoma City.

The McKee Construction Company of Muskogee, Okla., are purchasing equipment for constructing concrete bridges and culverts, and will engage extensively in that class of work.

The Crescent Cement Co., of Wampum, Pa., just west of here on the Pittsburgh & Lake Erie Railroad, have completed the purchase of the Beaver Coal & Coke Co.'s mines near Wampum.

SABULA GRAVEL CO.

Mr. V. O. Johnston has severed his official connection with the Lincoln Sand & Gravel Co., of Lincoln, Ill., and is now general manager of the Sabula Sand & Gravel Co. of Sabula, Ia. This company is installing a plant at Sabula, which will have a capacity of 20 cars per day.

CEMENT PLANT SOON TO OPEN.

There is much activity just now in the town's leading manufacturing institution, the factory of the Peerless Portland Cement Company, looking to an early resumption of manufacturing operations. The railway tracks to the clay pits south of town are being relaid and at Spring Arbor, where the marl is obtained, preliminary work is being done looking toward again going into the depths of the lake for marl. The annual repairs upon the factory machinery are completed, and the factory is in shape for the season's work. Although the beginning of operations will be late, the improved facilities will bring the season's output up to the average.—Union City (Mich.) Journal.

CONSTRUCTING CONCRETE PORCHES.

A booklet written by A. A. Houghton, fully illustrated. Price, 50 cents; sent on receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

CONCRETE BLOCKS.

The new building for the manufacture of concrete blocks has been completed by the Paragon Plaster Company, Syracuse, N. Y., and is under full operation. The building contains 30,000 feet of floor space, and the company will also add a large amount of new machinery to the brick plant.

CEMENT PRODUCTS.

Mount Carroll Cement Products and Construction Company, Mount Carroll, Ill., was recently incorporated. Capital, $12,000. Manufacturing cement products. Incorporators, Grant E. Hungerford, Luther E. Sisler, Merice J. Hungerford.

CONCRETE PORCHES.

A new book has just been issued by A. A. Houghton, viz: "Constructing Concrete Porches." A number of designs with a full explanation and working drawings of molds are given for ornamental concrete porch construction. Many styles of columns, pedestals and walls are successfully molded in these easily built molds, which cost but a slight expense of time and money to construct. Sent on receipt of price, 50 cents, by Cement & Engineering News, 1117 Schiller Bldg., Chicago.

REINFORCED CONCRETE CONSTRUCTION.

Reinforced Concrete Construction is the title of a 300-page publication by H. Adams and E. R. Matthews just received from the press. The book contains enough, and fortunately not too much, mathematics to make it interesting and valuable to the reader and treats in an exhaustive and practical manner all branches of reinforced concrete construction. More than 300 cuts illustrating modern work done in concrete add life and charm to the ambitious compilation. No contractor or practical superintendent striving for mastery in this art should be without it. Price, $3.00; forwarded postpaid by Cement and Engineering News, 1117 Schiller Bldg., Chicago, upon receipt of price.

A MODEL ERECTION SHOP.

"A Model Erection Shop" is the title of a very artistic 16-page booklet just issued by Lockwood, Greene & Co., architects and engineers for industrial plants, 93 Federal Street, Boston. It describes with illustrations the construction of a one-story, reinforced concrete, sawtooth roofed, machine shop which is unusually well lighted and at the same time has its floor area covered by an abundance of cranes running on concrete girders. The booklet will be sent on request to Lockwood, Greene & Co., 93 Federal Street, Boston.

CONCRETE COSTS.

A book containing tables and recommendations for estimating the time and cost of labor operations in concrete construction and for introducing economical methods of management, edited by the well known authorities on concrete construction, Messrs. F. W. Taylor and S. E. Thompson; authors of "A Treatise on Concrete, Plain and Reinforced." Price, $5.00; sent on receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

CONCRETE BRIDGES AND CULVERTS.

A new book on concrete and culverts (both railway and highway) by that well known authority and expert, H. Grattan Tyrrell, has just been received from the press. Leather, 4½x6¾; 272 pages. Post paid, $3.00. Sent on receipt of price by Cement & Engineering News, 1117 Schiller Bldg., Chicago.

CONCRETE BRIDGES, CULVERTS AND SEWERS.

An interesting little publication by A. A. Houghton, author of "Concrete From Sand Molds," "Ornamental Concrete Without Molds," etc. Price, 50 cents; sent on receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

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7/12

CEMENT
... AND ...
ENGINEERING NEWS

That the use of concrete culvert pipe for railway use is entirely successful and economical is evinced by the fact that in the last three years one manufacturer, the Fruit Growers' Refrigerating and Power Co. of Anna, Ill., has furnished pipe to the Illinois Central, Big Four, Mobile and Ohio, Monon, Chicago and Alton and the Chicago and Eastern Illinois Railways, and are at this time working on several large railway orders. This illustration shows their product in several sizes up to the maximum, 72 inches in diameter.

Their curing system is of particular interest. Concrete is poured into forms on transfer cars, which are then shoved on tracks into the steam room where the pipe cures for a period of 90 hours at a temperature of from 70° to 110° F. After this they are run out into the yard, and in the summer time are sprinkled at least three times a day for not less than ten days. The steel reinforcement consists of square corrugated bars of high carbon open-hearth steel. The mixture used is 1 part Universal Portland cement, 1½ parts torpedo sand and 3 parts crushed screened limestone, which is retained on a ¾ inch but passes a 1 inch screen. A strength of at least 50,000 pounds to the lineal foot is claimed for the product. This is a promising industry.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY

WILLIAM SEAFERT, Editor and Publisher

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

Advertising Rates Sent on Application

JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, JULY, 1912

FIREPROOF SHEET METAL PRODUCTS.

The fireproof qualities of concrete are undoubtedly one of the strongest arguments in favor of concrete construction and have helped to win for concrete the place which it enjoys now-a-days for residences, factories, and buildings of minor importance, in the city as well as in the country.

The lamentable fire loss in the United States, which is ten times as large as that of a number of European countries, comprising an equal population, will be reduced to reasonable limits the sooner the more rapidly builders become emancipated from timber construction and all kinds of interior finishes, which furnish food to the flames.

Many modern so-called fireproof constructions, as theaters, hotels, factories, residences, etc., have burnt, causing great loss of life. It is true the buildings themselves were not destroyed, but the damage done to human life showed that the term "fireproof construction" was a fallacy, as long as the interior of the buildings were filled with inflammable woodwork and decorations of all kinds.

A building becomes really fireproof only when all woodwork, like window frames, doors, floors and ceilings, is replaced by metal; and that this can be done in a very pleasing and artistic manner has been proven by the numerous exhibitions of sheet metal products, which formed part of our recent Cement Shows. There we have seen, for instance, the metal fireproof window frames, wardrobes, doors, ceilings, skylights and ventilators of the Canton Mfg. Co., of Canton, O., and of similar companies, imitating perfectly the various kinds of wood, thus affording the same warmth of color in the interior decorations we are accustomed to, and combining with it absolute indestructibility by fire.

Such side shows, in connection with our Annual Cement Exhibitions are, in our opinion, well worth remembering in planning concrete construction of a fire-resisting nature.

USE OF CARBORUNDUM GRAINS INSURES NON-SLIP STEPS AND WALKS.

The possibility of obtaining a concrete floor or sidewalk, which, under all climatic conditions, will be safe and sure underfoot, has long been discussed by those interested in concrete construction. It has always been the aim of the contractors to secure some substance to mix with their cement which would give not only a non-slipping surface, but add to the wearing qualities and still not detract from the appearance of the floor or walk.

Recent experiments in this country, as well as in England, Germany and France, have proven that an excellent material for this purpose is carborundum grain. Carborundum, made by The Carborundum Company, Niagara Falls, N. Y., as is well known, is as hard and sharp as any known material. It is just as hard as the diamond and in every other respect is a thing men have been looking for to use in making anti-slip steps, floors and sidewalks.

In European cities a number of big government buildings, public buildings, railroad stations and hospitals have the carborundum-concrete floors and in this country the runways in the Hudson Terminal buildings, the floors of the Hudson tunnel cars in New York City, and the Oliver building in Pittsburgh, have been treated with the carborundum grain.

The method of using the grain is very simple, and considering the results obtained, it is not at all expensive. After the first, or foundation layer of concrete has been laid, a mixture of 30 per cent carborundum grain and 70 per cent cement is spread. When the final or finishing layer of concrete is put on an additional quantity of the carborundum grain is troweled into the surface while the concrete is still green.

Gives an Attractive Surface.

There is no fear of detracting from the appearance of a floor or sidewalk in using the grain. Indeed, it adds to the attractiveness of the work, as it gives a pleasing, sparkling effect, each tiny grain or crystal of the carborundum grain being in appearance suggestive of diamond dust.

There is practically no wear to the carborundum grain, as the units are absolutely uniform in their hardness and whatever slight wear there may be will be evenly distributed over the surface of the floor or sidewalk, providing the grains are freely used. Then, too, the carborundum grains are just sharp enough to give the necessary "grip" to the cement surface and under almost every condition, it has been found that the floors or sidewalks in which they have been used, give a safe, non-slipping surface.

In various other ways carborundum grains have been used to the same advantage. For instance, in the frame work about the glass squares or circles used in sidewalk vault lights, carborundum grains have been embedded, with a result that a safe tread for pedestrians is secured. The sidewalk vault is, without a safe tread, a most serious menace to traffic even under dry weather conditions. With the application of the carborundum grains, however, a positively safe tread is possible and incidentally there will be little or no wear to the frame work. In the manufacture of safety tread steps, carborundum has been used for years, and the steps leading to the Brooklyn bridge, the subways in New York and the subways in Boston, are instances of the use of the grains. They not only safeguard millions of pedestrians, but show little or no wear, the steps outlasting, by years, steel or wooden steps.

National Sand and Gravel Producers' Association—New Organization

F. W. Renwick

Below we publish a likeness of Mr. F. W. Renwick, president and manager of the Chicago and Joliet Sand and Gravel Company, who was elected president of the newly organized National Sand and Gravel Producers' Association. Mr. Renwick as chairman of the convention spoke as follows:

"I believe it is customary for the chairman of a meeting to state first the cause for the meeting. Our friend, Mr. Defebaugh, has relieved me of a good deal of embarrassment. I presume you all understand that the call was issued to get together the producers of sand and gravel in the United States, to see if we could effect a permanent organization which would be of benefit to all of us. The cause of the organization perhaps can be best expressed in a few words by saying it is really to get acquainted. By getting acquainted I believe that we can make comparisons of ideas, tell our troubles to each other and profit by the other fellow's experience. Personally, I am looking for something like that. There are very few people in and out of the sand and gravel business who realize how fast the business is growing. I believe I am safe in saying that the business is growing faster than the people in it. Speaking for our own community, it is safe to say that the past five years all of us have been short on some particular class of material at some time of the year. Going even further back than the five years, I believe the demand for torpedo sand has exceeded the supply. This year we have been scarce of gravel. All of this points to progress in our growth, and is flattering in a way to the business.

"We have been up against a good many propositions that have only been solved so far by work and money. We might say some of it is wasted, as some of the gravel plants have not taken advantage of installing the most modern equipment. Some of the newer ones here whom I recognize are to be congratulated a little bit on breaking into the game and reaping some of the benefits of the older gravel folks. I think the equipment people will help us out in a large way.

"One of the particular points of the game which has been overlooked, as I understand it, is the lack of concentration of our own energies. None of us are very large; we do not make much of a showing individually. If we are put together and combine our efforts we can undoubtedly accomplish a great deal more than we can separately. The railroads themselves, which are an important factor in this game, have not been educated as fast as the business has grown. I can recollect perhaps 10 or 12 years ago when railroad rates were something ridiculous. They were charging twice as much for pulling gravel shipments as on coal. They have gotten over that to a certain extent today. Look at the favorable freight rates which the meat packers receive from the railroads. That is simply because the packers are organized. If we can get together and show the railroads we have some tonnage we will receive some consideration.

"I notice that the government report for 1910 shows shipments of sand and gravel for that year of 70,000,000 tons. That is really an increase of 10,000,000 tons over the previous year's shipments, but it is undoubtedly several hundred thousand tons short of the actual shipments. If we assume that the average rate of the shipments of this gravel is 35c per ton, you will see that the earnings of the railroads from the gravel industry alone are approximately $25,000,000 for the year, and this year means but eight months. Just think of it, monthly shipments of $3,000,000 going to the railroads. Very few products which they handle make as much money for them, and there is no reason why we should not have better freight rates than we have. There is a poor probability of our being able to get them by working alone in it. That, with some of the other points, when concentrated, should make the operation of our business much easier, and the results obtained thereby would be much better than they are at present.

"One of the things which I think we have all overlooked, which is important in its way, is the uniformity of the class of material we are producing, and the establishment of weights for all this material we are shipping. We all know the requirements for gravel and the uses to which it is being put are various. We cannot remember them, and if we are to undertake to make a grade of material for every use it is easy to see that our friends the equipment people are going to pay all the dividends. We cannot put 100 screens in a plant, but we should be able to bring the users of gravel to a moderate number of requirements, and the only way we can do that is to adopt universal sizes in material.

"I believe that the organization of this class of business people is bound to be productive of good results. They may be further reaching than we expect. If we can get together and exchange our ideas, tell our experiences, it surely is not going to be detrimental to us anyway, and it should be beneficial. Now the principal part of the benefit we will get is the discussion of matters of vital importance to the trade by every one present. I will say again that we are here to get acquainted. If you don't know everybody introduce yourselves; if you don't we will know you have not been in the business very long."

Other speeches were made. Mr. C. W. Boynton of the Universal Portland Cement Company delivered the following address:

"I think first that I should congratulate you gentlemen for getting together for such an organization as contemplated, because your business has developed very rapidly, and undoubtedly there are a great many things on which you can exchange ideas to your mutual advantage. Your chairman suggests that I talk to you this afternoon, but I assure you I did not come here to talk. As most of you know I am in the cement business, but our interests are so closely allied that I felt that I could come over here this afternoon without invitation and see what is going on and offer you any assistance that the cement industry can be to you. Certainly you could not find much of an opportunity to sell sand and gravel if it was not for Portland cement. On the other hand, it would be very hard for the cement manufacturers to find a market for their product if it was not for the producers of sand and gravel. I am not associated with the sales end of our business, but with the manufacturing end, and beyond that with the educating of the people to the proper use of our material, and think it is right along that line we can work together to the best advantage.

"I do not know what you might not undertake in

your organization, but one thing you will undertake I am sure is to educate the consumer to the proper use of your material. If for the sake of selling a commodity the prospective user is told that he cannot use it except in a certain way, and he makes a failure, the man who sold that commodity is a loser as well as the man who made the failure. Every one in the sand, gravel and cement business should be interested in seeing that it is a success, therefore we should offer to the successful user a material adapted to his purpose. The reason for this is that a mixture of sizes ordered by the prospective user may not suit his requirements, and by a study of your material you are in better shape many times to advise him what he needs than anyone else. We find in our business often architects and engineers, people who are supposed to know the best mixtures, and the proportion to use for the best application of concrete work, make mistakes, and you will find it in your business, and the experience that you gentlemen have had ought to fit you to educate

Mr. Renwick is also president of the Chicago and Joliet Sand and Gravel Companies, with offices in the Fisher Building, Chicago.

the other fellow and increase the consumption of your material.

"I can not talk very well on the line of sand and gravel, except as it is associated with cement. We find in our business that the consumption this year will compare very well with last year. The consumption of cement by the large consumer for the past few years does not compare favorably at all with the consumption of the larger user prior to that time, more especially with railroad work, but by a campaign of education we have been able to keep up the consumption of cement, and in some instances increase it, and believe this year will not show much less. An association can do 100 per cent more along the line of education than an individual., not 100 per cent more, but dollar for dollar. The public will take more kindly to educational data and facts handed out by an association than they will if the same data is handed out by individuals, because they always feel that an individual is looking for direct benefit. We find that so in our cement manufacturers' association. We maintain an office in Philadelphia for the preparation and distribution of all data available on the use of cement, and through that office we find we are very much benefited. Some of the larger companies do a great deal along that line themselves, and so long as the direct advertising is not made a part of the data handed out it is received from the individual with a good deal of interest. At the same time I find an organization has the advantage in that respect.

"I don't feel that I should take more of your time this afternoon, but Mr. Defebaugh and your chairman insisted that I should address the meeting, and rather than to have them feel that I wanted to shirk I consented. I want to assure you that in your work, whatever you undertake, the cement trade is very much interested in what you do, and we want to offer you all the assistance possible. If your organization is so perfected that we may become directly associated with you as to hold membership in your association, we shall be glad to work with you in any campaign of education that you may undertake, and I sincerely trust in your organization you will make it possible for us to work with you."

Mr. N. C. Fisher of the Garden City Sand Company also spoke. Mr. Fisher's address is as follows:

"I do not think there is any use trying to refute the statements that have been made here by Mr. Defebaugh, who has had experience in other directions of this kind, also the talks of Mr. Renwick and Mr. Boynton. Everybody who has come here today has no doubt felt benefited by the new people whom he has met. I can remember not very long ago it was unusual to meet very many people in the gravel business. It has had its ups and downs, and has come very rapidly into prominence in the last five or six years. I can remember in this market particularly only recently that gravel was not considered as an article of commerce hardly. Way back in the early part of our career gravel was used for making cedar block streets, and there was practically no call for torpedo sand, and it was thrown away. After a while torpedo sand began to be used a little bit. We used to buy it at 50 cents a carload already screened, and at that time we felt as we do now that there was certainly a future for it, and it has steadily gained all along the line. Finally torpedo sand came into prominence and there was no use for gravel. Take in our own city, where stone had a long start in the concrete business, because we had stone quarries right in the city and did not have any freight to pay. We found that there was a use for gravel after a while, and it has been steadily growing, and I think it is general all over the country.

All Should Be Interested.

"There is no question that we are ready now to form a permanent organization, and as already stated, we should all be interested, because there are a great many problems to solve in this business which are different to any other business. As representing our company I am certainly in favor of a national organization. I did not think so at first, because I thought it was principally a local business which might be gotten together in certain places, but I have been convinced to the contrary. I believe it is the proper thing to do, and with the constant changing of freight rates going on all the time we ought to get together and declare ourselves once in a while and show that we are alive. A freight man said yesterday that the railroads are bound to get more revenue, and they are going to get it from the point of least resistance, and the traffic manager who is alive is looking out for the business, and if we do not organize we are liable to have the rates advanced on our product. I heard of a num-

ber of cases where rates had been raised without any notice. By getting together all these matters can be determined, and there can be no question regarding the benefits of a national association."

Report of the Committee on Resolutions.

Resolved, That it is the sense of this committee that the need of co-operation is responsible for the meeting of the representatives here to-day to bring out all the good features of the material we produce and emphasize the service rendered in being prepared to deliver promptly materials that are a large factor in the structural business of the United States; and be it further

Resolved, That it is the sense of this committee that the membership of this organization is intended to cover producers of moulding, silica, glass, bank, torpedo, building engine sand, and all grades of sand and gravel; and be it further

Resolved, That a special effort be made to secure the membership and co-operation of all producers in this country that in annual conclave we may be able to consider all phases of the business and outline plans for a larger market on good business lines; and be it further

Resolved, That at all annual meetings of this association that papers be prepared and given on subjects covering the operations and marketing of our product, discussion of freight rates, legislation, building laws and requirements of railroad and industrial companies; and be it further

Resolved, That it is the sense of this committee that we encourage and foster local organizations in all sections, these organizations to advance the local interests of the producers to conserve their raw materials and secure such railroad legislation as will advance and protect their interests in said local community; and be it further

Resolved, That each member will take upon himself the burden of encouraging all producers of sand and gravel, to become members of and affiliate with this organization.

GOOD GRAVEL FAR BETTER THAN LIMESTONE FOR CONCRETE WORK.

The moral support of the entire sand and gravel interest of the country is due the producers of the Cincinnati district in the situation that confronts them there. The city authorities are opposed to gravel in municipal work, and the gravel men are seeking information that will enable them to show the officials the error of their ways. Appeal was made recently to President Renwick, of the National Association of Sand and Gravel Producers, for information of this kind, and he replied in effect as follows:

"I am enclosing you an extract from the Chicago Council proceedings during the year 1908, at which time we were having the same sort of trouble that you are evidently experiencing. This 1908 controversy, however, was principally in comparison of the relative merits of torpedo sand and limestone screenings. Our fight on gravel really dated back to about 1904. Any engineer who discriminates in favor of crushed limestone over good gravel for use in concrete does it either through ignorance or dishonesty. The United States government has on its staff some of the best and highest priced engineers in the world, and they, without exception, give gravel a preference in their concrete construction.

"This was evidenced in our own district by the fact of their specifying gravel and torpedo sand for construction of the new Naval Training School, thirty miles north of Chicago, and at a point where limestone could be bought cheaper than the gravel. Engineers of the city of Chicago were until a few years ago so partial to the use of limestone that gravel was not permitted in specifications for macadam concrete, sidewalk work, or curb and gutter, but this was undoubtedly due to the fact that the gravel people had not organized their business nor arranged their plants for producing gravel in suitable sizes and quantities, while the stone people were working under one of the best combination organizations in the country.

"Today gravel is not only permitted in all Chicago specifications, but frequently specified to the exclusion of limestone, as in the case of combination of curb and gutter. The same applies in private work, as is evidenced in the erection of many of our largest commercial buildings. The Montgomery-Ward building, in Chicago, which is the largest reinforced concrete building in the city, specified gravel in preference to crushed stone, although stone could have been delivered by boat at a much cheaper rate than the gravel, which necessitated a railroad delivery. The Corn Products Company plant at Argo, Ill., which is probably the largest concrete plant in the state, was also built of gravel concrete, although erected in the stone quarry center of Chicago. The new plants of the American Bridge Company, the American Sheet and Tin Plate Company, and the Pittsburgh Screw and Bolt Company at Gary, Ind., are all constructed of gravel concrete in preference to crushed stone, although stone could be delivered at as low, or a lower price than the gravel. We meet very few up-to-date engineers today who do not admit that they would prefer a concrete built of gravel than of limestone. The reason is obvious, as concrete is no stronger than its weakest part, and we know that a gravel stone is stronger than limestone. No further evidence of this is necessary than the fact that a yard of gravel weighs five hundred pounds more than a yard of crushed stone.

"Years ago we were continually confronted with the argument that cement would not adhere properly to the round or smooth surface of a gravel stone, nor so well as it would to the cubed edge of broken limestone. The fallacy of this argument was soon shown by the blasting of gravel concrete in which some of the stones were broken in two ways without releasing the cement from the outside edges. Certainly the thin edge of a cube stone is much weaker than the heart of the stone, which is naturally much thicker, and would therefore break easier at this point than at any other. In addition to this the sharp edges of the cube stone not only bridge on themselves, but will do so on the form work, and thus create an unusual amount of voids which are apt to be left unfilled by the finer particles of the concrete, also leaving a rough surface when the forms are removed. Our progressive engineers appreciate all these points, as well as the result of numerous comparative tests which are continuously being made, so that in this locality at least we have nothing to compete with in specifications except price. I believe that if your council is on the square, and your city engineer possessed of the average intelligence, you will have no trouble in getting gravel placed on at least an equal basis with crushed stone for any kind of concrete or macadam work. That has been our experience in Chicago, and, as I said before, the gravel people have done it strictly on the merits of their goods and in the face of a strong organization on the part of the stone people."

OIL AS A WATERPROOFING.

Director Page, of the Office of Public Roads, is a most active influence in the effort to secure the most substantial and permanent form of road making and to make use of the materials most accessible and economical in character. Recently he gave this question some careful consideration before the Indiana Engineering Society at Indianapolis, and we are giving our readers his deductions.

There is perhaps no constructional material of present-day use with more universal adaptation to a great variety of structures, than Portland cement concrete. In most instances where the design has not been at fault this material has given eminent satisfaction. Concrete, however, does not always serve the purpose for which it was intended. It has many virtues, but its still unconquered faults continually assert themselves. Construction cracks, due to atmospheric temperature changes, to the heating and subsequent cooling of the mass while hardening and to the drying out of the water, are apparent in many concrete constructions. Then, again, concrete is not as impermeable and non-absorbent a material as is desirable in a great many structures.

Much experimentation has demonstrated the possibilities of the proper grading of the aggregate towards securing impermeability by increasing the density of the mass. More or less benefit has likewise been secured through the void filling effect of finely divided powders, and various patented processes.

The possibilities of residual mineral oil as a waterproofing agent were discovered by the writer in October, 1909, in the laboratories of the Office of Public Roads. He found that when mineral oil was added to Portland cement paste it disappeared after mixing for a few moments, due to the emulsifying effect on the lime in the cement. The cement thus treated set quite readily and without any accompanying separation of the oil. It was noted that the behavior of water on the surface of oil-mixed mortar was quite different from its action on plain mortars. Its absorption by the oil-mixed mortar appeared to be extremely small or nothing, while it was quite greedily drunk by the plain mortar.

The addition to concrete of a greasy, inert substance like oil, possessing no inherent cementitious properties, with the intention of benefiting the mixture, was a startling radical departure from accented engineering practice, and it was therefore determined to investigate as many of the properties of the material as limited time and facilities would allow.

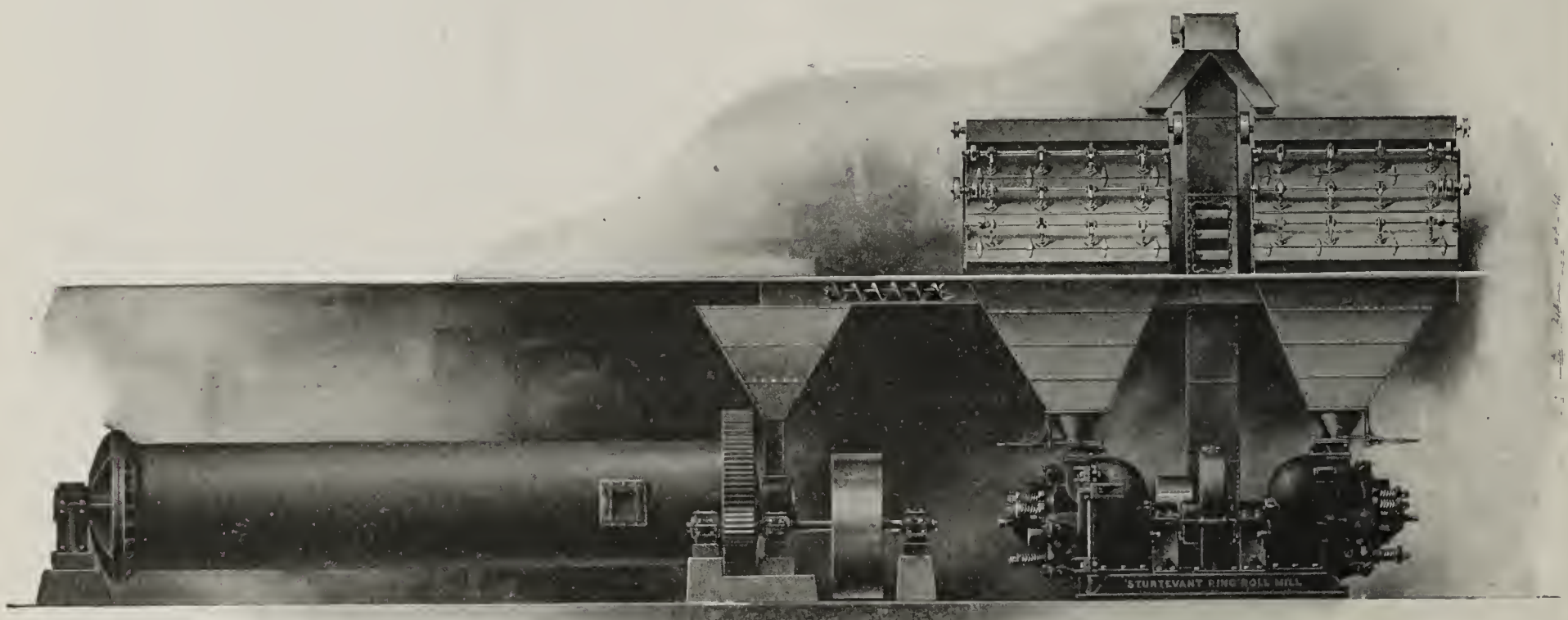
If oil was beneficial as a waterproofer, was it at the same time promotive of serious weakness? Would the elasticity and toughness of the concrete be greatly different from these properties in ordinary concrete? What was the most effective type of oil to use? These were some of the questions to be solved and the following tests were started in the laboratory to determine the most important properties of oil-mixer mortar and concrete:

1. Absorption.
2. Permeability.
3. Tensile Strength.
4. Compressive Strength.
5. Time of Setting.
6. Resistance of Impact.
7. Bond Tests.
8. Modulus of Electricity.

Materials:

The materials used in the various tests were Portland cement passing the specifications of the American Society for Testing Materials, clean river sand well graded from ¼ inch down and ¾ inch crusher run gneiss of a rather poor quality. Gravel concrete specimens were likewise made.

STURTEVANT GIANT RING ROLL MILL.



"Cement Unit" Comprising a Sturtevant Giant Ring Roll Mill, an elevator, two separators and a tube mill, considered one of the most efficient combinations of grinding machinery for cement clinker, limestone or coal.

THE USE AND STABILITY OF REINFORCED CONCRETE IN SEA WATER.

By Raymond Baffery.

(Note: The recent disclosures of the failure of the concrete piles used in the construction of the piers along the water front of San Francisco has led to some inquiry about the probable durability of concrete in sea water. While this was due to faulty construction, still the test of time is the thing. This paper, read before the seventh annual convention of the National Association of Cement Users, held at New York, will no doubt be of interest to our readers.)

In view of the thorough manner with which the subject of concrete in sea water was covered at the last Convention, it would seem appropriate to preface this paper with an apology for the failure to present any striking novelty or final solution of the problem. The somewhat conflicting theories entertained by persons qualified to speak with authority on the chemical aspect of the case renders it necessary for the ordinary engineer to approach the matter with considerable diffidence. It may be of interest, however, to review the concensus of opinion regarding the chemical and physical effect of sea water on concrete and to describe a few of the more important works constructed in European waters within the last fifteen years, showing the wide range of application of reinforced concrete to maritime structures.

Several years ago when the attention of the engineering profession was first called to the rapid development of the concrete industry it was feared that reinforcement imbedded in concrete submerged in sea water would be subject to deterioration. Today, however, it is generally admitted that reinforcement in dense concrete will not rust.

In 1907, a block of concrete was broken off from a pier constructed in the Bay of Audierne, France. The anchoring steel rod was in a perfect state of preservation, although it had been imbedded in the seawater since 1848.

Iron bolts in perfect condition were found in a piece of concrete chipped off a dry dock built in Brest, France, about 100 years ago.

In 1881, Mr. W. T. Douglas, Engineer of the Light House Commission, England, when wrecking the Eddystone Light House, built in 1857, found a bundle of iron rods in perfect condition embedded in Aberthaw lime cement.

In 1906 a part of a Hennebique pile, driven in 1898, was taken to the laboratory for examination. The steel was found in an absolutely good condition.

In the matter of concrete in sea water, we find the same theory opposed to the experience of the last twenty years. One firm alone has designed over two hundred docks and piers since 1898, aggregating some $3,000,000 worth of work and has not yet organized a department of chemical engineering.

It is impossible at the present time to state definitely what reaction takes place when Portland cement comes into contact with certain salts contained in sea water. We know that the magnesia sulphate and the sodium sulphate in the sea water act on the free lime in the concrete to form calcic sulphate and calcic sulpho aluminate. In a porous concrete the formation of the salts, with the corresponding increase in volume, causes a certain amount of expansion and resultant checking of the concrete surface similar to the effect of frost on porous stone. The mechanical action of the waves accelerates the abrasion of the surface and therefore concrete structures in seas subject to tide suffer more than those in still water.

Two ways have been suggested to avoid the chemical action of the sulphates contained in sea water on the free lime and the aluminates contained in the set cement. First, it has been proposed to add to the cement some chemical compounds, which in combining with the free lime would form a compound free from the action of sulphates; this has led to the addition of puzzolona, trass, etc. Second, it has been proposed to eliminate the aluminum from ordinary

Apartment Building of Concrete Blocks.

Portland cement and replace it by iron which would avoid the formation of the calcic sulpho aluminate, supposed to be the ill effects in concrete. However, the situation is further complicated for us by the fact that the sea water varies in different parts of the continent and also by the presence of sewerage near the large cities on the seacoast. By using a compact, impervious concrete, well set, the action can be eliminated.

It is obvious that in order for a chemical reaction to take place the molecules of the mixture must be in intimate contact, hence if concrete is impervious to water, the action will be confined to the outside surface. In fact, as is seen in such concrete structures subject to sea water for over 15 years, the action is absolutely nil.

Suggestions as to incorporating waterproofing compounds in the concrete or painting the outside surface with coal tar preparations have not given as uniformly satisfactory results as a rich and well graded concrete of medium consistency.

Too much stress cannot be laid on the absolute necessity of grading the sand and stone to make a dense concrete, varying the proportions, if necessary, as the product of different crushers or gravel banks is incorporated in the work. It should also be noted that nearly all important work in England and France in recent years has been coustructed with a very rich mixture, generally about 1:1½:3.

It is universally admitted that a medium or quaking consistency of the concrete is to be preferred to either the very wet or the very dry mixtures and furthermore it is essential that reinforced concrete in small sections shall be well cured in air before being subjected to the mechanical effect of the sea water.

Sea water work can be classed under three different headings:

1. Work where mass concrete is used, such as gravity walls, locks, shore protection, etc.
2. Work where reinforced concrete piles and concrete sheet piling are used such as wharves, piers and jetties.
3. Reinforced concrete caisson work.

I. Mass Concrete.

Mass concrete has been used for centuries in sea water as ordinary masonry and its advantages from the standpoint of speed and economy have long been recognized. In Italy today we find sea walls built by the Romans with a concrete having as a binder puzzolona and lime cement. Concrete blocks have been cast on shore, transported and sunk in place in the same manner as granite.

The disadvantage of gravity walls are at once apparent, since the life of the superstructure is absolutely dependent on the foundation and the latter is subject to scour. It has been found more economical to design monolithic structures.

Shore protection works are generally much lighter, not being designed for earth pressure but rather for the protection of the coast from erosion.

A wall was constructed at Dieppe, France, in 1901, with a parabolic cross-section, having a short vertical tangent at the top to throw the water back into the sea. The height of the embankment is about 26 feet, the concrete being 16 inches thick for the first 4 feet of the height and 12 inches thick for the balance. It is reinforced vertically and horizontally by a network of rods. Some time after the wall was built, a heavy storm washed away the masonry wall built at the end of the reinforced concrete wall, while the latter withstood its action perfectly.

At Belle Henriette, France, a wall was constructed with a line of concrete sheet piles 12 feet long. The shore was covered with a slab of reinforced concrete supported at intervals by concrete piles.

A simple shore protection is given by means of grooved reinforced concrete piles supporting reinforced concrete shingles. These "Groynes" are erected near Brighton, England.

II. Reinforced Concrete Structures.

Reinforced concrete piles caused to make the greatest step in the use of reinforced concrete in sea water as wherever in a structure a wooden pile was used a reinforced concrete one could be substituted with the great advantage of obtaining permanency, simplicity and uniformity in construction.

The first concrete sheet piles were used at the Sables d'Olonne in 1898, to reinforce an old masonry sea wall. The heads of the piles were capped with reinforced concrete beams anchored back to the masonry. The piles were 16x10 inches in section, 19 feet long and reinforced with six ⅞-inch rods, the concrete being proportioned 1:1½:3. This work is in as good a condition today as it was at the time of construction.

In the same year a jetty was constructed at Southhampton, the Woolston Jetty, 136 feet long, with a river frontage of 100 feet. The foundation consists of reinforced concrete piles. The deck was designed as an ordinary beam and girder floor. Ten years after its erection, the owners, Mordey, Carney & Company, stated that it was in as good condition as when first erected. "It had cost nothing for maintenance, and the only money spent on it was for the slight repairs entailed by a collision in 1901, when a large steamer crashed into it, but without causing anything more than local injury."

The fact that reinforced concrete piles can be made on shore with selected materials and subject to proper inspection has led to their adoption for foundations in sea water in all parts of the world.

The Daggenham Coaling Jetty, Essex, England, was built in 1901. The jetty is 780 feet long and 35 feet wide with 78 feet between the river bed and the deck. The piles were driven in groups of three encased in reinforced concrete cylinders also filled with concrete. It carries railway rolling stock and four transporter cranes weighing 60 tons each.

The plant with which the cylinders were placed was constructed at the Eastern Wharf, Dundee. The original wharf was 410 feet long. Since then two extensions, one 380 feet and one 310 feet, have been built. It might be noted in this connection that there is a 12-foot tide at Dundee, and the climatic conditions are more severe than at Boston, Mass.

The Kings Dock at Swansea, England, was built for the Great Western Railway, and is 750 feet long and 50 feet wide. Another pier 1,100 feet long has since been erected in the south side of the pier. This wharf has accommodations for three fixed and two movable tips.

The Prince of Wales Pier was built in 1903 at Falmouth, England. The construction is similar to that of the Daggenham jetty.

Another big wharf was built for W. G. Armstrong, Whitworth & Company, at Newcastle-on-Tyne, England. This wharf is 920 feet long and 45 feet wide, carrying a turret shop with a floor load of 900 pounds per square foot.

A wharf was built at Ravenna, Italy, in which the wooden piles in the old structure were replaced with reinforced concrete piles. A similar wharf was built in Nantes France, in 1902, with piles 45 feet long.

A good example of the light and graceful framing possible in reinforced concrete design is shown in an amusement pier built at Arcachon, in 1902.

The use of concrete sheet piles was shown in the construction of sea walls at River Itchen, Southampton, in 1897, for the London and Southwestern Railway Company. The adjacent faces of the sheet piles are provided with grooves. These are filled in, after driving, with cement grout, thus insuring a good joint between the piles.

Concrete piles were used as reinforcement of the old quay walls at Boulogne. The masonry wall, constructed many years ago, showed a tendency to tilt under the pressure of the earth. Its stability was retained by removing the earth fill and constructing a concrete floor supported on concrete piles.

III. Reinforced Concrete Caissons.

Caissons of steel and wood are considered more as methods of construction than as permanent works, adding nothing to the strength of the structure. On the contrary, concrete caissons can be designed to serve as permanent construction. They have taken the place of the immersed concrete blocks which were used some twenty years ago to form foundations on which breakwaters, quay walls, etc., were constructed. In open seas, these concrete blocks had to be of large dimensions in order to resist the pounding of the waves; hence it was advisable, in order to facilitate the placing, to make the blocks hollow, float, sink and fill them with concrete or other suitable material.

The breakwater at Madras has been constructed by means of cylindrical steel caissons 42 feet in diameter and 53 feet high, which were filled with concrete in two operations. In the first one concrete was deposited so as to partially sink the caisson, 7 cylindrical openings being left through the mass; in the second one, these cylinders were filled.

At Heyst-Zeebrugge, Holland, the rectangular caissons were 82 feet by 24 feet 8 inches, and 29 feet 6 inches high; they were of steel divided into three cells by transverse partitions. The caissons were sunk in place and filled with concrete.

At Rotterdam, Holland, a sea wall was constructed by using reinforced concrete caissons constructed in a dry dock, then floated and sunk in place, using concrete of lean mixture for ballast in order to give the necessary stability. These caissons were 35 feet long.

At Toupase, Russia, a jetty was built with reinforced concrete caissons 56 feet long and 21 feet wide and 6 feet 22 inches high, averaging 250 tons when empty and 1,600 tons when filled.

In this country several reinforced caissons were built during the last two years. One application consisted in constructing the piers of a yacht wharf at Glen Cove, L. I. The caissons were 12x12 feet and 17 feet high. The constructor used a compound which is a resinate of calcium and silicate of alumina; it generates a silicate of lime and a silicate of alumina in crystalline form, and both of these materials are immune from the action of sea salts. A light house foundation was constructed at Huntington Harbor this summer by the same method.

By far the most striking example of reinforced concrete caisson work is the artificial island of the Battery des Maures, used as a torpedo testing station by the Schneider Iron Works in France. This is simply a large concrete box 77x55x51 feet. In this case it was necessary to make an artificial island in a bay in order to obtain a stretch of still water several miles long—about 700 feet wide and 35 to 40 feet deep. The owners first planned to construct a large steel caisson and sink the same by means of compressed air, but no contractor would submit a proposal within reason in view of the possibility of the plant being destroyed by storm. It was next planned to build up an island by means of heavy artificial blocks, but it was feared that the dead weight of the superstructure in this case would be insufficient to withstand the heavy seas.

Cement Stucco Residence of E. W. Deming No. 2 Richmond Place, New Orleans, La.

R. Spencer Soule, New Orleans, Architect.

Stucco finish on Clinton No. 21 gauge V-stiffened Wire Lath galvanized after weaving.

A reinforced concrete caisson was finally designed by the Paris Hennebique Office and constructed in a dry dock up to a height of 51 feet. When floated the submerged depth was about 11 feet 6 inches. The caisson was then towed to a place already prepared near the shore where all the interior was completed. The lower cells were filled with sand, as it was considered necessary to obtain a draught of about 26 feet for safety in towing. In the first place the caisson was floated previous to its being sunk in its final place. The next step was to tow the caisson some 22 miles. This was done against a heavy sea at the rate of about a mile an hour. The site had already been dredged to about 50 feet below mean high water and the caisson was sunk by pumping water into some of the interior cells. The last operation was to complete the superstructure. All these steps were completed without delay and at the completion of the job the contractors thought it would be entirely possible to take out the ballast at any time and tow the caisson to another site.

These few examples of typical concrete structures show the wide range of adaptability of reinforced concrete. Most of the work described above were built between 1897 and 1903. Practically no special precaution was taken in selecting the sand, stone, Portland cement; it was, however, considered very important to use rich mixtures, these being generally 1 cement, 3 sand; or 1 cement, 2 sand or gravel; or 1 cement, 1½ sand, 3 gravel—the proportion between the fine and the coarse aggregate being dependent on the percentage of voids.

In general the works described have withstood perfectly the ten or twelve years of action of the sea and do not show any destructive effects, except where concrete is porous or the steel reinforcement is too near the surface. At Dundee, where the winters are very severe and the tides high, the reinforced concrete piers are in perfect condition; this seems to show that even the combined action of frost, sea water and pounding of waves have no ill effect on well constructed reinforced concrete works. It must be recalled, however, that in most cases the works herein described such as pile work or caisson work, the concrete was allowed to harden in air and was not subject to the sea action before it had matured at least 30 days.

This paper would be incomplete if we made no mention of the works which have not been quite successful.

At the Charlestown, Mass., Navy Yard, a quay wall built of mass concrete shows signs of disintegration. The effect is localized between the low and high water marks and takes place after a severe frost. Authorities in charge of the work place the blame to the porousness of the concrete, as the water penetrates the pores and by freezing expands and causes the concrete to scale off.

At Hussum, Germany, a sea wall built in 1905 also shows signs of disintegration. The mixture here was rather rich, but the concrete was deposited dry. Soon the surface subjected to sea water was covered with a white scum, then cracks appeared and later parts scaled off exposing the reinforcement.

Similar ill effects have taken place at few other points. However, it seems that usually the concrete was found to be porous. Further action has been stopped by covering the surface with a waterproof material, such as cement finish, coal tar preparations, Kessler Fluats, etc. It may also be mentioned that in some places, in Germany especially, trass has been used, the mixture being ½ trass, 1 cement, 3 sand, 4 gravel, but the addition of trass retards the setting of the cement.

Notwithstanding the poor results of some reinforced concrete construction in sea water in this country—in spite of the uncertainty whether we obtain a concrete always immune under any physical conditions from the action of sea water salts, and last, but not least, in spite of the prejudice which our leading engineers have against any new type of construction, not only by private interests but also by the War and Navy Departments of the United States, England, France, Germany, Denmark, Sweden and Russia.

The few works described give only a limited idea of the great strides made by reinforced concrete in sea water works. It can be stated that in this field of engineering reinforced concrete will prove, as it has with buildings, bridges, etc., to be the most permanent and economical material.

CONCRETE BRIDGES.

A new book has just been issued by A. A. Houghton, viz.: "Artistic Concrete Bridges." The construction of ornamental concrete bridges with full details of the easily built molds are explained. A successful form of collapsible center or core for the construction of concrete bridges, culverts and sewers is illustrated with working drawings to enable anyone to construct same. This is a new and successful type of collapsible core mold and is not patented. Sent on receipt of price, 50c, by Cement and Engineering News, 1117 Schiller Bldg., Chicago.

QUARRY BUSY AT PETOSKEY, MICHIGAN.

Superintendent John Nyman, of the Petoskey Crushed Stone Company's crusher, southwest of the city, announces that the large plant has started up full blast with twenty-eight men employed, each of them having had their pay increased 25 cents per day.

The large plant has been idle, but the small plant has been in operation. With the resumption of activities by the former the latter was shut down.

Crusherville presents a busy aspect now, and another feature of industrial Petoskey has started its good work again.

WHITE CEMENT.

The Santa Cruz Portland Cement Company's plant at Davenvort, Cal., has long been experimenting with the manufacture of white cement, which is in strong demand here for finishing purposes, selling at about $7 per barrel. It is now announced that the experimental stage is past, the output in this line being equal to anything produced in the East, and manufacturing on a commercial scale is to be started this month.

THE MECHANICS OF BUILDING CONSTRUCTION.

A book written by H. Adams, dealing with the mechanical principles of building construction, containing 590 diagrams fully illustrating every phase of design. Price, $2.00. Sent upon receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

CALIFORNIA SAND-LIME BRICK COMPANY.

The Standard Brick Company is the name of the new concern recently incorporated with $100,000 capital stock, at Redlands, Cal. They will erect a plant for the manufacture of sand-lime brick.

Steam Tests on Concrete and Mortar.

The effect of high-pressure steam on the crushing strength of Portland cement mortar and concrete has been investigated in the Technologic Branch of the United States Geological Survey at the Structural Materials Testing Laboratories, St. Louis, Mo., of which Mr. Richard L. Humphrey was engineer-in-charge. The following notes are taken from the report of the tests made.

It is a well-known fact that the hardening of Portland cement is accelerated by exposure to heat after hydration, but the value of this acceleration and the possibilities of its application to commercial purposes have not been extensively investigated.

In the manufacture of cement products, such as building blocks, architectural stone, drain tile, sewer tile, fence posts, etc., it is highly desirable to produce a material of uniform and known quality. Under present methods of manufacture the product is not of uniform quality. Even under laboratory conditions of manufacturing, storing and curing a variation of 50 per cent in strength may be obtained between maximum and minimum values for similar concrete, mixed and moulded under apparently the same conditions.

At the present time many manufacturing plants find it to be to economical and highly desirable to cure their products by exposing them to heat in the form of steam at atmospheric pressure. By this means it is found that the concrete becomes sufficiently hard in the course of several days to permit handling and shipment. The heat accelerates the setting and also aids in the production of a more uniform quality of material.

The purpose of the investigations reported in this paper was to determine what acceleration in hardening could be obtained by using steam under pressure, with corresponding higher temperatures.

Outline of Tests.

There were two series of investigations: (1) To determine the effect of different steam pressures on the hardening of Portland cement mortars. (2) To determine the effect of duration of steam exposure on the hardening of Portland cement mortars.

Inasmuch as mortar mixtures are extensively used in the manufacture of cement products, and since it was thought they would give relatively similar results to those which would be obtained with concrete mixtures, one mortar mixture exclusively was tested. This mortar was composed of 1 part by volume of Portland cement to 4 parts by volume of well-graded sand. Two percentages of water were used in mixing, corresponding to those employed in moulding cement products. One has been termed a damp consistency, the mixture containing only sufficient water to permit of moulding a ball in the hands and holding between the thumb and finger. Water could not be drawn to the surface by troweling. The other, designated a "quaking" consistency, contained all the water it would hold and permit of making a ball in the hands and holding between the thumb and finger. Water could easily be drawn to the surface by the pressure of a trowel.

Unfortunately the second series of tests was not made until eight months after the first series. The same cement was used in both series but it was stored in galvanized-iron cans during this period and became slightly lumpy. The large lumps were screened out by passing the cement through a ¼-in. mesh sieve, and an endeavor was made to crush the small lumps; but it would appear from the results that the tests were affected somewhat by this difference in the quality of the cement, due to its age and condition, and the results of the second series are not directly comparable with those of the first series. However, each series is complete in itself and gives the desired information.

Tests of Constituent Materials.

Only one sand, Meramec River sand, from Moselle, Mo., was used in these investigations. It is composed of flint grains having comparatively smooth surfaces.

Illustration No. 1 is an excellent view of a Receiving Plant where sand is unloaded directly from the barge by means of a derrick and a Hayward Automatic Clam Shell Bucket, presenting the maximum of economy from a rehandling standpoint. In this case, the bins are erected of re-inforced concrete and the bucket is so arranged that it will place the sand in any bin desired. The capacity of this plant for unloading from barges and delivering to wagons is 500 cu. yds. per day—a moderate capacity with a Hayward Clam Shell Bucket.

Simplicity in any undertaking is desirable, though not always possible. In Illustration No 2 is shown a simple, yet effective and profitable means of taking sand and gravel from a sand bar 20 ft. deep with a Clam Shell Bucket. In addition, a washing and screening plant is used, which conveys the material under the cableway, where in turn it is picked up once again with the Bucket and placed on railroad cars.

The yellowish brown color of the flint imparts a tint of the same color to the sand as a whole.

The cement used is known as typical Portland cement, being prepared by thoroughly mixing together a number of Portland cements. The average chemical analysis of the individual brands of cement used is as follows:

	Per cent
Silica	21.70
Alumina	8.53
Ferric oxide	2.23
Lime	62.00
Magnesia	1.74
Sulphuric anhydride	1.67
Water	.43
Ignition loss	.98
Undetermined	.94

Details of Tests.

Although the proportions of the mortar mixture are stated by volume measure, they were converted into their weight equivalents for greater accuracy in measuring the individual batches, an allowance being made for the moisture contained in the sand. The weight per cubic foot of the cement was assumed as 100 lb. and the cubic weight per cubic foot of the dry sand was 100.6. This weight was determined under standard conditions as reported in Bulletin 329 of the United States Geological Survey. The moisture contained in the sand, as taken from the storage bin, was determined on a small sample each day. The weight of sand required for a batch was increased in amount equal to the percentage of moisture found to be present in the sand, and the quantity of water required to be added for the desired consistency was decreased in amount equal to that found to be present in the sand.

The materials were mixed in a cubical batch mixer. They were mixed dry for five minutes when the water was weighed, added, and materials mixed another five minutes.

The test piece was cylindrical in shape, 8 inches in diameter by 16 inches in length. The cast iron mould in which these test pieces were formed is in three sections, held together by brass eye-screws and iron wedges. The inner surfaces are machined true.

The mould was filled one-fourth full and hand tamped systematically with 13-lb. peen-shaped tamper, care being taken to cover the entire surface. This operation was repeated until the mould was filled, when it was leveled off with a plasterer's trowel.

The moulds were placed in the moist room immediately after filling, and the following day they were removed from the test pieces. After steam treatment all test pieces were stored in the moist room (with a few exceptions) until they were tested. The test pieces which were not steam treated were not removed from the moist room until the day when they were due to be tested. All test pieces in the moist room were sprinkled three times each 24 hours.

Steam Treatment.

The steam-curing equipment consisted of a curing tank 36 inches in diameter by 10 feet in length, with one head removable; three steel flat cars 24 inches wide by 30 inches long, track, steam-pressure regulating valve, steam trap, steam gauge and necessary piping. The steam was obtained from the power plant of the laboratory.

The method of subjecting the test pieces to steam was as follows: Twenty-four hours after the test pieces were moulded, the moulds were removed and the test pieces were placed on the flat cars. The cars were rolled into the tank, the section of the track at the entrance of the tank was removed, and the head of the tank which was suspended on a rail was rolled into place and bolted. An outlet valve and the back pressure valve were opened to permit the air to exhaust with the entrance of the steam. The steam valve was then opened, permitting the steam to flow through the pressure-regulating valve into the tank. It required from 15 to 45 minutes to exhaust the air from the tank and bring the steam up to the desired pressure. For low pressures a mercury column was attached to the tank for greater accuracy in reading. The high pressures were read directly from the steam gauge. When the desired pressure was reached the regulating valve was set. After the desired period of steaming the entrance valve was closed and the outlet valve, back-pressure valve and the steam trap were opened, permitting the steam to exhaust from the tank. When the pressure was removed, the head of the tank was unbolted and removed. The cars were drawn from the tank, the test pieces removed, and either tested immediately for compressive strength or stored in the moist room until they were due to be tested.

Compression Tests.

The ends of the cylindrical test pieces were smoothed off with plaster of Paris at right angles to the axis a short time before testing. The method of applying this plaster cap was as follows:

The glass-top table used for this purpose was oiled, plaster of Paris was spread on it about ¼-inch thick, and into this the cylinder was forced so that all but a layer about 1/16-inch thick was squeezed out. The sides of the cylinder were kept vertical by means of a spirit level. After the plaster was set, the test piece was removed from the glass and the other end was treated in the same way, both ends being made parallel, and the perpendicular to the axis.

The test piece was placed in the testing machine without further bedding. The load was applied continuously at a speed of about 1/40 inch per minute until failure. The gross deformation readings were taken on one test piece from each set of three similar test pieces, readings being taken at 5000-lb. intervals or about 100 lb. per square inch. The ultimate breaking load and the appearance of the ruptured cylinder were recorded. Two testing machines of 200,000 and 600,000 lb. capacity were used in the tests.

Results of Tests.

All test pieces were calipered and weighed previous to testing. The weight per cubic foot of the concrete or mortar was computed by dividing the weight by the volume computed from actual measurements of each test piece. The ultimate strength in pounds per square inch was obtained by dividing the total breaking load by the sectional area computed from the actual measured diameter.

The gain in strength of the mortar exposed for 24 hours to steam at 80 lbs. per square inch over the untreated mortar is 632 per cent. This amounted to 4487 lbs. per square inch for a 1:4 mortar thus treated against a strength of 613 lbs. per square inch for the untreated mortar. Lower steam pressures give a corresponding increase in strength over the untreated mortar, and from the slope of the curves it would appear that the increase in strength would be correspondingly higher for higher steam pressures and temperatures.

The results show no retrogression in strength with age in any case. The untreated mortar does not equal in strength the steam-cured mortar at any period, and at the age of 180 days it has less than 50 per cent of the strength of the mortar steam cured under 80 lbs. pressure for 24 hours.

All mortar exposed to steam under 80 lbs. pressure

for from 12 to 48 hours resulted in an increase in compressive strength over the untreated mortar. The increase in strength is from approximately 400 per cent at the age of two days to 100 per cent at the age of 28 days. The steam treatment of only 3 hours duration apparently had an injurious effect upon the hardening of the mortar, as that mortar developed only 60 per cent of the strength of the untreated mortar at the age of 28 days.

In order to determine the effect of steam on a lean mixture, one set of cylinders was moulded of one part Portland cement and eight parts of sand, using 12½ per cent of water. They were permitted to obtain an initial set in moist air for 24 hours, when they were exposed to steam under 80 lbs. pressure for 24 hours. They were tested immediately after removing from the steam, being two days old, with the average ultimate strength in compression of 2128 lbs. per square inch.

From these tests it would appear that the strength of a steam-cured mortar is directly proportional to the cement content, but of course too much dependence should not be placed on a few results. One set of limestone concrete cylinders made in the proportion of one part of Portland cement, three parts sand and six parts limestone was made and tested. They were placed in moist air for the first 24 hours, obtaining an initial set, after which they were exposed to steam at 80 lbs. pressure for 24 hours. They were tested directly after taking from the steam, being two days old, with the average ultimate strength in compression of 2445 lbs. per square inch.

Those cylinders tested which were exposed to the effects of steam after acquiring an initial set failed either by diagonal shear or shear combined with a bulging at the center.

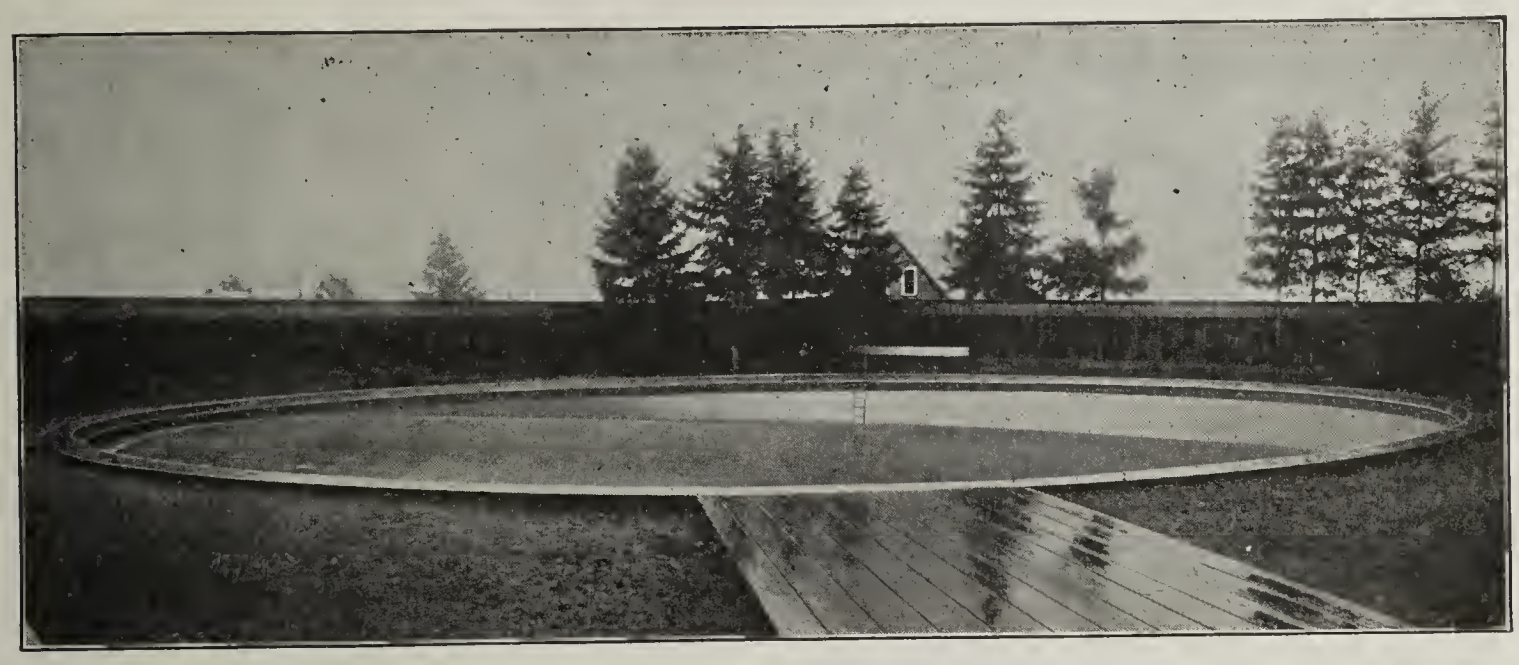
Several sets of cylinders, both mortars and concretes, were exposed to steam immediately after moulding without permitting the material to obtain an initial set. In every case the test pieces were cracked longitudinally by the steam, but the concrete or mortar was hard and the test pieces developed about half of the strength of those which were permitted to obtain an initial set before exposure to steam. It was found that if the concrete was mixed to a creamy consistency, although it was permitted to set in the air for four days previous to exposing to steam, the test pieces would be cracked longitudinally by steam action.

Several sets of cylinders were made in which hydrated lime was substituted for part of the cement, but the strength was reduced almost proportionally with the reduction in the cement content, the lime acting apparently as so much inert material.

Summary.

Those in charge of the investigation state that the conclusions drawn on tests of this character must be understood as only directly applicable to materials similar to those tested and they must be limited by the limitations of the investigation. However, the test piece was of good size, and considering the large number made and tested, the reliability and accuracy of the results may be accepted. Their conclusions are summed up as follows:

1. Steam up to 80 lbs. per square inch gauge pressure has an accelerating action on the hardening of Portland cement mortar and concrete.
2. The compressive strength increases as the steam pressure is increased.
3. The compressive strength increases with the increase in the time of exposure to steam.
4. A compressive strength considerably (in some cases over 100 per cent) in excess of that obtained normally after aging for six months may be obtained in two days by using steam under pressure for curing the mortar.



SELLWOOD CONCRETE SWIMMING TANK, PORTLAND, ORE.
Walls and Floor Waterproofed with Trus-Con Waterproofing Paste.

5. Steam under pressure, if of sufficient duration, permanently accelerates the hardening of the mortar, giving subsequent constant increase in compressive strength with age.
6. The steam-cured mortar or concrete is of much more uniform appearance and much lighter in color than normally aged mortar or concrete made from the same materials.
7. The mortar or concrete should obtain an initial set before it is exposed to the steam treatment.
8. For steam curing a "quaking" or medium consistency is preferable to a very dry or a very wet consistency.
9. The initial modulus of elasticity and the yield point of the mortar increase directly with the duration of steam treatment.
10. The initial modulus of elasticity and the yield point of the mortar increase directly with the steam pressure.
11. The initial modulus of elasticity does not increase in direct proportion to the increase in the ultimate compressive strength of the steam-cured mortar.
12. Results indicate that the compressive strength obtained by steam curing is directly proportional to the cement content of the mortar.

Unit Construction

Observation of a New Yorker in We tern Cities

In speaking of his recent trip to Kansas City, where he was in attendance at the convention of the National Association of Cement Users, the superintendent of buildings in Manhattan, Rudolph P. Miller, called attention to an apparently unique construction used in two buildings of that city, in which the fronts were practically entirely of glass, says the Record and Guide. The columns supporting the front were set back about six feet, and the floor construction was cantilevered out to support the glass and light cast iron facias which formed the two-foot panels under the windows.

In one of the buildings, located on a corner, for architectural as well as structural reasons the fronts were finished at each end with pavilions about ten feet wide of brickwork faced with white glazed terra cotta, which encased the only columns placed on the building line. The pavilion, with a frieze immediately under the cornice, forms a sort of frame for the large window surface. The interior is very light, and the tenants seem to be very well pleased with the arrangement. Mr. Miller feels, however, that for a closely built city the construction is not to be commended, on account of the great exposure hazard.

The most interesting matter that came to his attention during his trip was the rapid development that is taking place in the construction of reinforced concrete buildings by the use of separately moulded members, which the advocates of the method call the "unit construction." Superintendent Miller examined a number of buildings of this construction, both in Kansas City and St. Louis. In finished appearance they are hardly distinguishable from the ordinary poured concrete structures. Tests which have been made seem to show that for the same general design the construction by the unit method is the equivalent, so far as strength is concerned, of the ordinary method of construction. Under certain circumstances there is a very marked economy in this unit form of construction. One of its advantages is well shown in the stack house of the National Lead Company at St. Louis. A one-story structure, 750 feet long and 160 feet wide, especially designed for the manufacture of white lead, was turned over in part for occupancy while the rest of it was under course of construction, without in any way interfering with the use of the finished portion. It is contended for this system that the columns, girders, beams, floor slabs, etc., being cast under factory conditions, can be much better inspected, and there is more certainty of their being exactly correct after being put in place.

A novel and interesting cement product which came to Superintendent Miller's notice is now being rather extensively used in Kansas City and towns within shipping distance, is the hollow cement columns made by the Trusswall Manufacturing Company of Kansas City. It is said that for residences they can be furnished almost as cheaply as wooden porch columns, with the advantage of greater durability. The surface of the finished work has a texture quite its own, which is very pleasing in appearance. The columns, which can be finished round, square or fluted, with any style of base or cap, are made under a patented process on a lathe, over a collapsible wooden form. Reinforcement is stretched on the form, and the fairly dry mortar is placed to a thickness not much greater than that required for cast iron columns of equal size, and shaped to the form desired. By using a dry mixture and adequate reinforcement the danger of small cracks is practically eliminated. With the use of white cement a very good result is obtained. In the building examined where these columns were used, they were found to harmonize well with the stone used for trim or bases.

In regard to the convention proceedings, Superintendent Miller said that the papers read and the discussions thereon brought out many items of interest to the building fraternity. These will appear in the proceedings to be published by the association as soon as the same can be properly edited. It is surprising to Superintendent Miller that more builders, contractors, architects and engineers do not avail themselves of the benefits of this association and its published proceedings, which may be had at a small cost. The association is doing excellent work in the preparation of standard specifications embodying the best practice in cement construction of all kinds. Their reinforced concrete regulations are being extensively followed and are used to great advantage in the preparation of the regulations recently adopted by the five superintendents of buildings of this city.

In some further remarks about his trip Superintendent Miller said:

"A matter that is receiving much attention at the present time is the study of the aggregates used in concrete, especially the sand. It has been too frequently assumed that any sand used with cement would make a satisfactory mortar, and when mortars have been unsatisfactory the cement has been generally blamed. It appears, however, upon fuller investigation, that more often the sand is unsuited. Fortunately, the material used for concrete aggregates in New York City are, generally speaking, above suspicion in this respect.

"The magnitude of the work of the association carried on through its committees is indicated by the report of the committee on reinforced concrete, describing the tests undertaken in concrete buildings at an expenditure in the last year of about $10,000, contributed by a number of members to the research fund, for the purpose of determining the actual stresses developed in the concrete and the steel under load. The details of the tests are too technical to describe here, but it is gratifying to know that in actual practice the materials are not being stressed beyond the safe limits given by our present regulations, and at the same time that the working stresses specified by our regulations are fair and proper.

"In an interesting paper Mr. E. L. Heidenreich discussed the design of reinforced concrete grain elevators. Its adaptability for this purpose should be sufficient reason for prohibiting the use of wood for not only grain elevators, but for similar structures, such as coal pockets, ice houses, etc. It is to be hoped that

any new building code that may be presented for adoption in New York City will require that such structures be of fireproof construction. Numerous examples can be cited, showing that this is only a reasonable requirement in this day, irrespective of location. In thickly populated sections fireproof construction should be called for to remove the fire hazard from surrounding buildings; in sparsely settled sections to avoid certain total loss in the event of fire.

"Among the numerous matters that engaged the attention of the convention, the topics that would most interest those employed in building construction were the design of concrete piles; the proper method of measuring concrete, so that disputes between the contractor and the architect may be avoided on such work; the desirability of making field tests of concrete as the work proceeds, a practice not uncommon with some of the leading contractors for that class of work; the design of reinforced concrete retaining walls, by which economy of space may be effected, as well as economy of cost; the design of the so-called flat slabs, a form of floor construction that is appealing strongly to owners of buildings because of its many advantages in industrial buildings; specifications for cement stucco to produce a satisfactory result and to eliminate the various troubles now experienced with this material."

Superintendent Miller mentioned the fact that the president of the association, Richard L. Humphrey, in his annual address, showed by a large number of lantern slides the more advanced state of reinforced concrete construction in Europe. Architects and engineers over there, particularly in Austria, seem to catch the spirit of the material and seem to think in concrete, so that the style that is being developed appears to be more expressive of the material itself.

PAINTING CEMENT BUILDINGS IN GERMANY.

The publication in Daily Consular and Trade Reports for January 3, 1912, of an article on building methods in Hamburg, prompts inquiry in regard to the class of paint used on cement structures in Germany. It is claimed that large amounts of money are expended in the United States in painting cement and concrete, with unsatisfactory results, the paint either peeling or discoloring rapidly.

According to information obtained from builders and architects, the principal precautions taken in northern Germany to prevent the peeling of oil paints is to defer their application until the cement is quite dry. When it is intended to apply color on outside walls which are still damp, water paints are used which are weather-proof and which can be washed if necessary. These colors, necessarily, are not impervious to moisture.

In his textbook for 1910, Dr. Glinzer, director of the State Building School in Hamburg, says that to make oil paint adhere to cement the surface of the material should be coated with diluted sulphuric acid (1 part concentrated acid to 100 parts of water), which afterwards must be washed off and the surface allowed to dry. Or the surface may be covered with diluted silicate of soda (wasserglas), the solution to be 1 to 3 or 1 to 4, and applied three times in succession. Still another method is to apply two coats of building "fluat" at least 24 hours apart. Practical builders state, however, that the applications of sulphuric acid are not made by them, and such success as they have results merely from careful work and the use of good materials.

DUSTING OF CEMENT FLOORS.

The fact that so many of the cement floors in our reinforced concrete buildings today cause worry to the architect, contractor, owner and tenant, by the surface dusting off with slight wear, thus becoming a menace to machinery, employes and stock, has necessitated a study of the cause of this trouble.

Upon investigation it will be found, first—that the most serious cases are on floors above the basement, which fact would lead us to believe that the concrete has not had proper conditions for the thorough crystalization of the cement. This to a certain extent is true, for the basement floor has been in contact with the damp ground, and, not being exposed to heat and air both below and above, has not had a chance to dry out so rapidly.

On the more exposed upper floors, however, the drying out is much more rapid, the top dressing being especially affected and thus being given a tendency to become soft and crumbly.

There is another cause, too, for this dusting, and that is—improper troweling, such as over troweling, or troweling while the initial set of the cement is taking place. For by troweling, a suction is formed that disturbs the particles, which is as injurious as the breaking up of a bond after it has formed. Lack of protection of floors in cold weather, and the freezing of the surface, will also cause this top dressing to scale and dust off.

There is, too, a general cause of this trouble in the use of sand, not carefully inspected, in that in the troweling, foreign substances are brought to the surface that will not incorporate, and prevent the thorough bonding of the sand and cement.

To overcome this difficulty, contractors have frequently had to take up large surfaces of floor and relay, and then find the same trouble, and generally end in condemning of the cement used.

It is with the intent to bring some of these facts to the notice of users of cement in general, and one of the successful remedies for this trouble, that suggested this letter. As an operator I have made many floors hard and crystal-like at very small cost, that otherwise undoubtedly would have had to come up and be relaid, by the simple method of applying a cement coating in liquid form. This hardens these porous surfaces harder than the floor itself, and in addition, makes them impervious to water, uniform in color, and prevents staining or disintegration from the dripping of oil on them.

C. T. B.

JERSEY GRAVEL.

A delegation of operative builders called upon Chief Clarke of the Bureau of Building Inspection of Philadelphia, to protest against the recent order of the bureau forbidding builders to use anything but Jersey gravel in foundation work, unless the material had first been submitted to the bureau and had withstood the test imposed upon it. The builders complained that the order was unjust to them, as the Jersey gravel is controlled by a combination, which keeps prices up. Chief Clarke refused to rescind the order, calling the builders' attention to the fact that Jersey gravel was not specified as the only material that could be used. but that other materials were permissible, if they came up to the standard of strength required by the bureau. The order on the use of Jersey gravel was issued as the result of the collapse of several buildings, in the construction of whose foundations it was found gravel of inferior strength had been used.

WATERPROOFING AGAINST PRESSURE.

The accompanying sketch shows quite clearly the operation of a device which is being successfully employed for filling cracks and stopping leakages in concreted tunnels which are subject to external water pressure. Minute cracks or larger unfilled crevices extending entirely through the material seem to inevitably occur in the most carefully constructed subaqueous tunnels, these either being found at once upon the completion of the work or developing later in the consequence of natural shrinkage or from the jar and strain of heavy traffic. The resulting inflow of water is a constant source of annoyance and expense, and if not quickly remedied results in delay or stoppage.

On account of the water pressure, leakage of this character can never be stopped by the application of paints or cements upon the exposed surfaces, as they are washed away as soon as applied. The water which is flowing through the cracks must first be driven back and the space it occupies must be filled with the waterproofing material, and this material must have the property of adhering where it is placed and of immediately assuming a permanent hardness, thus not only making a filling but also a binding or strengthening material. The Mica Paint employed in connection with the apparatus has been demonstrated to completely satisfy all these requirements, and without it, or some equivalent if discovered, the operation could not be a success.

Referring to the cut, which is to be regarded as a sketch only, and not suggestive of actual dimensions or of the details or practical application, a large cast iron bowl is placed over the crevice to be stopped and made as airtight as possible by a thick, yielding gasket against the cement surface, with the brace and screw jack behind it to resist the pressure. Compressed air is then turned on sufficient to drive back the water, and the Mica Paint is then admitted to the bowl and, backed by the air pressure, is driven in to fill the cracks. When one crack, or a portion of it, has thus been treated the bowl or airtight chamber is placed to cover another crack, and so on until all the leakage has been permanently cured.

This is beyond the stage of experiment and is a demonstrated success, having been employed upon the Hudson River Tunnels of the Pennsylvania Railroad and elsewhere with most satisfactory results. The operation as described seems simple enough, but in the practical employment of it of course judgment and experience count for much, and especially does the success of it depend upon the use of a filling material which completely satisfies the imperative requirements. The Mica Paint as a paint, has been thoroughly tried by the paint experts of the New York Central, Baltimore & Ohio, Pennsylvania Railroad and the American Car & Foundry Company for steel cars. Both the apparatus and the paint are controlled by The Mica Paint Company, 76 William Street, New York.

The Interstate Commerce Commission has declined to disturb existing freight rates on cement in the middle West, "except as to Oklahoma, where certain reductions are made to place Oklahoma on a substantial parity with other cement rates in this general territory."

Certain cement mills in Kansas complained to the commission that their rates on cement to Kansas City and destinations in Missouri, Nebraska, Colorado, South Dakota, Montana, Oklahoma and Texas were unreasonable and discriminatory. With the exception of the Oklahoma rates, the tariffs were permitted to stand.

Some Experiments With the Curing of Tile

By George P. Dieckmann, Mason Cit , Iowa

In carrying out a series of experiments to determine the best method for the curing of cement tile, it was my aim to find out the best, cheapest and most practical method to accomplish these results. Two years ago a series of similar tests was conducted at the laboratory of the Northwestern States Portland Cement Company's plant at Mason City, Iowa. These tests were made on small briquettes, and I presented these results at that time. My recent experimental work was carried out along the same line as before, but this time the tests were made direct on cement tile.

I was in hopes of presenting results on longer time tests, but on account of the severe winter I was too much handicapped to do so. It is my intention to start the same series of tests over again on a longer time period, so that the results given now may still be considered only preliminary.

In making these tests, I will state that all tests were made on machine made tile, 8x12-in. and 1-in. wall thickness, the average weight of the tile being 24 pounds. The material used was one part Northwestern States Portland Cement, tested and passed according to standard specifications, to 3½ parts of sand from the Hawkeye Cement Tile Company's pit at Mason City, Iowa. This sand had the following granular composition:

Retained on 10 mesh sieve	11.2
Retained on 20 mesh sieve	26
Retained on 30 mesh sieve	22.5
Retained on 50 mesh sieve	21.3
Retained on 100 mesh sieve	16.2
Passing on 100 mesh sieve	2.2
Percentage of loam	4½

The Ames Junior tile testing machine was used for the experiments on crushing strength.

No. 1. The tile, after moulding, was kept in air for seven days. Total crushing strength average, 800 pounds.

No. 2. The tile, after moulding, was kept in air for seven days, and sprinkled with water twice per day. Total crushing strength average, 1,350 pounds.

No. 3. The tile, after moulding, was kept in air for 24 hours, then immersed in cold water for six days. Total crushing strength average, 950 pounds.

No. 4. The tile, after moulding, was kept in air 24 hours, then immersed for six days in hot water, at a temperature of 90 degrees F. Total crushing strength average, 1,200 pounds.

No. 5. The tile, after moulding, was steam cured for 36 hours in steam curing room, the exhaust steam temperature of this curing room, 86 degrees F. The steam was applied during the day time only for three days, no steam during night time, making a total in the curing room for three days. The remaining four days, the tile was kept in air. Total crushing strength average, 2,000 pounds.

No. 6. The tile was made the same as No. 5, with the exception that after being removed from the curing room the tile was sprinkled with water twice per day for four days. Total crushing strength, 1,800 pounds.

Two tiles which were made in 1908 and stored for three years in the yard show a crushing strength of 3,000 and 3,500 pounds respectively.

I will now present to you the results obtained by curing cement tile, applying steam pressure of 5 and 10 pounds respectively. In order to carry on this work a cylinder 10 feet long and about 2 feet in diameter, and closed on both ends, was used. The boiler from which the steam was obtained maintained from 80 to 90 pounds of pressure, which was reduced by a reducing wall on the cylinder to the desired pressure of 5 and 10 pounds. The Jenkins trap was used to draw off the condensed water.

No. 7. The tile, after moulding, was placed in the steam cylinder and gradually, for several hours, 5 pounds of steam entered the cylinder. The tile was found collapsed.

No. 8. The tile, after moulding, was allowed to harden for 2, 4, 12 and 24 hours. Placed in the steam cylinder and gradually 5 pounds of steam entered the cylinder for a period of 8 hours. The tile 2 hours old was found partly collapsed, while the 4, 12 and 24 hour tile appeared to be hard, but when placed under the machine the 4 and 12 hour old tile broke before the load was applied. The 24 hour old tile showed a total crushing strength of about 800 pounds. The tile was very dry.

In order to supply more moisture during the curing, a perforated pipe was placed along the inner top of the steam cylinder. The perforating was made like a sprinkler to allow the wetting of the tile all over.

The tile 12 and 24 hours old was subjected to 5 pounds pressure for about 8 hours, at a temperature of 217 degrees F. Total crushing strength average, 800 to 900 pounds. Tiles 12 and 24 hours old were then subjected to 10 pounds steam pressure for 8 hours at 225 degrees F. Total crushing strength, 800 to 1,000 pounds. The same tile subjected to 10 pounds pressure test after 7 days, total crushing strength, 1,000 pounds.

The results obtained from my experiments for the curing of cement tile with steam under pressure are very unsatisfactory. However, I intend to investigate this method of curing more fully, but I do not believe that this method will replace the common steam curing, using exhaust or moisture steam, as the equipment, maintaining and operating a steam curing plant under pressure will be more expensive.

From my experiments on these tests I might add the following conclusions: The curing of tile in exhaust or moisture steam for 36 or 48 hours respectively, seemed to give the best results. After the tile is properly cured in this way no sprinkling or wetting is necessary. The highest crushing strength obtained was about 3,000 pounds, which is considered a good test. Eight inch tile cured in exhaust steam for three days, tested after being old seven days, 2,000 pounds, showing that two-thirds of the total strength can be developed in seven days, which is certainly all that could be expected. The curing of tile air only was very unsatisfactory. Sprinkling of the tile showed a considerable increase above the air curing. The curing of tile in cold and hot water showed good results. The common steam curing showed the highest results.

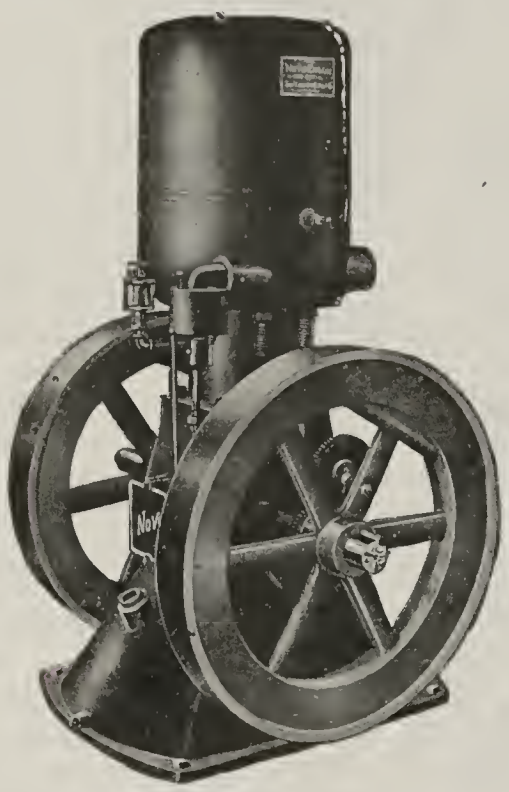
I believe that a great deal of uncertainty can be overcome if the tile manufacturer is equipped with a tile testing machine. These machines are very simple and can be bought or built for reasonable prices, and would be a valuable asset to any manufacturer. The manufacturer would then be in position to regulate the mixture accordingly, and most of all, would impress the prospective buyer with the superior quality of his goods against other competition.

THE "NOVO" GASOLINE ENGINE.

Any manufacturing concern is certainly entitled to a little pardonable pride when its products meet with favor from other firms. The Novo Engine Company, 219 Willow street, Lansing, Mich., is justly proud of the successful record of their "Novo" gasoline engines, when used as a portable power in connection with concrete mixers. At the present time Novo engines furnish the power for over twenty different makes of mixers, and in every instance they are giving excellent satisfaction.

The "Novo" Gasoline Engine.

The light weight, for the power delivered, of the Novo, combined with its compact design, makes it an extremely desirable power for portable use. The cooling system is such that it combines the desireable features of both the air cooled and water cooled type of engine. The cylinder and combustion chamber is cast integral with an open-top water jacket, which has no restricted or confined spaces; therefore the small amount of water used for cooling the cylinder can do no harm should it freeze. The advantage of "No Tank, No Pan, No Freezing," is one well worthy the consideration of the manufacturer of concrete machinery.



Another important feature that has been added to the design is the placing of both inlet and exhaust valves in removable cages. Both cage and valve may be removed for regrinding or repair without disturbing any other part of the engine, and the only tool needed is a common monkey wrench. The crank case of the Novo is entirely closed, fully protecting the connecting rod bearings from dust, and a thoroughly efficient lubricating system insures the engine long life.

The fuel supply tank, of ample capacity for a full day's run, is placed in the base of the engine, making it compact and entirely self-contained in every way. A noticeable feature of this line of engines is the small amount of piping and pipe fittings used. All plumbing is done away with in the cooling system, and the short lengths of pipe used to conduct the gasoline to the carbureter are of such size that there is little or no possibility of their being clogged. The carbureter is of very simple design, with no delicate valves or working parts.

The Novo engines are manufactured in four sizes as follows: The Novo, Jr., a strongly constructed pumping engine of 1 HP., 2½ HP., 3½ HP., and 5 to 6 HP., and the makers announce they are building a 1½ HP., and an 8 to 10 HP., and expect to have these sizes ready for distribution after Sept. 1st.

It will prove to the advantage of any firm in need of a reliable gasoline power for use in connection with portable machinery to write the Novo Engine Co. for their late catalogue.

THE CEMENT SIDEWALK.

Every city and town administration throughout the country to-day should be vitally interested in securing uniform and permanent sidewalks for its inhabitants. It is a matter which cannot help but be of interest to the administration which is alive and up-to-date. It is no longer a question of building well enough "to keep the pedestrian out of the mud," but of putting down a sidewalk which **will last,** one which will be a credit to the community on account of its general appearance. Up to the present time, no material has been discovered which can compare in durability, appearance and economy to the sidewalk built of cement. To-day there are thousands of miles of cement sidewalks in the United States and many more are under construction. It is not only the duty of every administration to see that the sidewalks are built of the material which is durable, but the right of every property owner to have a sidewalk in front of his place which is the best that can be built. The effort each city or town expends to bring this state of affairs about is small in comparison with the good which the community itself receives as a result of a permanent improvement of this kind to say nothing of the enhancement in prestige which such improvements bring about.

HYDRATING LIME SYSTEMS.

The Weller Manufacturing Company has an extensive plant on West North avenue in Chicago, and are manufacturers of complete hydrating systems. Hydrated lime is forging its way ahead and the consumption of it is rapidly increasing in all sections of the United States. Retailers of building materials everywhere are being attracted to it as a material easy to handle and which gives the utmost satisfaction. Users and contractors are rapidly becoming educated in its use, so that the market is constantly on the increase and now hydrating plants are in demand in many sections. The Weller Manufacturing Company's system of hydrating is shown on another page in this issue. This company has a staff of mechanical engineers who are prepared to co-operate in all problems pertaining to complete systems, including crushers, conveying systems, etc. The Weller hydrator has features that are peculiarly distinctive; for instance, it has an adjustable feed and also an absolute regulation of the water supply. It is light, but of very strong construction, which feature assures the economy of installation, etc., as something that is to be desired wherever machinery is to be put in. This company also makes hydrators of any capacity. They are also manufacturers of the Weller conveying and power transmission machinery and other lines of equipment that our readers are interested in.

Keeping a Cement Building Uniform in Color

Cement frequently has several shades of color after it is dried. To make a building uniform in color wash the entire surface with cement made by mixing two parts of Portland cement and one part of marble dust with sufficient water to reduce it to the consistency of whitewash, and apply with a whitewash brush. Wet the wall before applying the wash and keep it constantly wet during the work. This is decidedly important, as the wash will not adhere to a dry wall.

Some of the Uses of Sand.

There was a time when man was admonished not to build his house on the sands. Now he disobeys that injunction by going it one better. Today he builds his home of sand itself. In Biblical times people were not acquainted with the sandstone sand-lime brick. As a building material this had its origin in Germany some forty or fifty years ago. It is but recently, however, in this country at least that the value of the discovery has been to any extent appreciated. There are two or three well-known systems of manufacturing it, each of which has its warm supporters. Under one system, which has met with considerable favor in the United States, coarse and fine sand, separately put through a drier and then a measuring machine, are mixed together. Lime is then added, six parts of the latter to ninety-four parts of sand. Water is poured in, as required. If raw lime is used, the composition of sand, lime and water is stored in a hopper for the complete hydrating, or slaking of the lime. This process usually takes from twelve hours to one day's time. The mixture is then ready for the presses. These are ponderous affairs, of enormous power, capable of exerting a tremendous pressure. In the space of a second and a half the particles of sand are rammed and crushed into a solid mass. The freshly pressed bricks are then piled on a little car, about 1,000 to the load, and shoved into a baking cylinder, which is then bolted up. Steam and chemicals do the rest of the work. The steam in entering this cylinder first passes through the chemical, which is deposited upon the brick.

The bricks are simultaneously baked and dried in the oven, and when the head of the cylinder is removed, are ready for market. Mineral oxide is the chemical driven in with the steam, various shades of pink and yellow being thus produced.

Glass—the basis of which is sand—is being extensively used today as a fireproofing material, and in the form of bricks it has been tried out for construction purposes. That was an ideal that appealed instantly to the imagination—a home constructed almost entirely of ground glass, through which, even in cloudy weather, a soft restful light would be diffused. To the housewife it would mean hard walls upon which she might dash water to her heart's content. In short, the idea presented was one of cleanliness and comfort, combined with novelty and artistic effect.

It was several years ago when glass brick was produced by casting in a mould. Its really satisfactory qualities were offset in large measure first of all, by its high cost. For that reason, architects were reluctant to adopt it for general use. Moreover, it was found to be peculiarly susceptible to breakage in the course of transportation. Lastly, it had an unfortunate tendency to chip. There was one decided advantage the glass brick had over all other forms of building material: being hollow and, therefore, a most indifferent conductor it protected the interior of office or home against extremes of heat or cold.

Thist most decided merit, however, could not offset such deficiencies as just described. Cast glass tile, on the other hand, has been used to a considerable extent, and one the whole with satisfactory results. When the surface is once scratched, however, it quite easily fractures. It is necessary to make the glass tile very thick to prevent this.

But concrete is the real foundation of the building industries. Its plastic characteristics, together with its remarkable strength, rigidty and imperviousness to frost and moisture and heat, when properly set, easily entitles it to this position.

But the mere addition of sand is not, in itself, of value to the user of concrete. Indeed it may weaken the structure. This is especially true if worn, rounded grains of like size are employed. Smoothness of surface and regularity of size militate against adhesion. By employing sands from various screenings, the mass dovetails together with the least possible number of voids. The kind and quilty of sand to be selected is one of the big problems of the concrete constructor. In the rougher sorts of work where strength is not so much a factor no special knowledge or very special care need be exercised. Ordinary pit sand will be found to be quite satisfactory.

Indeed, it sometimes gives to the composition a greater strength, which seemingly increases with age, as the compound becomes fixed. This is due to the porous nature of the softer sands. Not only does the mortar bind the grains closely together, but it finds entrance into the pores. Thus the individual grains unite with the cement, forming when dry a remarkably compact, and well-nigh indestructible whole. Where, however, it is desirable or necessary to exclude moisture, the harder siliceous sands serve to much better advantage.

PECK PIVOTED BUCKET CARRIER.

A contract has recently been closed between the Pacific Rock and Gravel Co. and the Link-Belt Company of Chicago through the agency of Harold H. Clark, local representative of the latter company, office at 312 Security Bldg., for a Peck pivoted-bucket carrier to handle crushed rock to and from a large ground storage to be installed by the rock company at their Puente Largo plant, says the Los Angeles Building Record. This machine will take care of about 5,000 tons storage of various sized rock and will have a carrying capacity in either direction of from forty to sixty tons per hour. The path followed by the carrier is rectangular in shape, passing under and over the storage piles and railroad tracks, supported above by a timber trestle. The buckets can be dumped at any one of the several points, thus distributing the rock over the storage space and discharging direct into railroad cars. The Peck carrier is in extensive use all over the country for handling rock, sand, cement clinker, coal and other materials, and has proved to be a most durable and efficient machine.

THE NECESSITY FOR DRAINAGE UNDER CONCRETE SIDEWALKS.

The one great fault with nearly all pavements laid, writes Edward Godfrey of Pittsburg, Pa., is that they are made of dry concrete, and the next great fault is that the finish coat is not applied immediately. It takes but a casual inspection of paving work in any large city to see that both these faults are extremely common. Just a few days ago I noticed some concrete pavement in front of the latest large structure in this city being put down with concrete that showed dry spots as soon as it was tamped. A slab of dry stones with a little mealy mortar rammed in between them cannot help being dished when it hardens. The apparent "upheaval" of the soil beneath is no doubt often the mere shrinking of the top coat, the only real concrete in the pavement. Some pavement in our neighborhood showed these dish-shaped blocks that are supposed to be due to heaving of the soil around the edge of the slab from frost. One of these slabs finally broke in, and a great cavity was exposed beneath it. The pavement had really sunk; there was no sign whatever of lack of drainage nor of upheaval of the ground. If it had been placed on the natural ground, not picked up and loosened and then perfunctorily tamped, after some loose stones or ashes had been dumped in, it would not have caved in so badly, provided, of course, good wet concrete had been used.

I put down some pavement in my yard last fall and I laid it right down on the undisturbed ground. Some blocks are seven or eight feet long. There is no sign of upheaval of the soil. The pavement was made in alternate blocks and was reinforced with old chicken wire and a few 1/8-inch wires.

I see much pavement being laid in the following manner: The paver will put down the base of dry concrete and tamp it. The next day (or if Saturday, the next week) he will put on the top coat. It is impossible to make a first-class pavement in this way. This method is not confined to rural or out-of-town work. It is common in down-town work, in front of large office buildings and in front even of reinforced concrete buildings, where the contractor is supposed to know how to make good concrete.

There may be cases where underdrainage is necessary, but there are, no doubt, many more where the loosening up of the ground and imperfect tamping are far more harmful than it would be to leave the ground in a beaten state and lay the concrete on it. Where a pavement occupies the full width between curb and building, as in down-town streets, underdrainage is useless, because the water will practically all wash into the gutters.

Men who have grown gray making concrete pavements are the very ones who insist upon making them of mealy concrete with the finish coat put on sometimes several days after the base is laid. It is clear to see why they use this method. They can lay 100 feet or more of mealy concrete base and cut slits in it in a sort of way, using a small gang, and then mix their mortar finish some time later with the same small gang and score the surface in the neighborhood of the slits. Troweled smoothly this pavement looks very well from the time it is finished until it is paid for, which is the important time for it to look well. These same practical pavement makers pay great attention to underdrainage. If they would use a few wires in the slabs and wet concrete and make the pavement in alternate blocks, the blocks could be much larger and would be more uniform, less subject to cracks, and better in every way.

Dry concrete, delay in placing the top coat, and excessive troweling characterize the greater part of sidewalk laying. All three are very serious faults and all three are adhered to very tenaciously by the majority of sidewalk layers.

CHICAGO & NORTHWESTERN RAILWAY TO MANUFACTURE CONCRETE SLABS IN CLINTON, IOWA.

The Chicago & Northwestern Railroad Company is making preparations for the manufacture of cement slabs, to be used in bridge construction on its system.

A series of large platforms is being built between Second street and the bridge, about 450 feet long, and on these platforms the slabs will be manufactured. A pipe line will be run from the pump house to furnish water, and the location is an advantageous one for loading and unloading of cars.

The slabs to be manufactured will be of great size. They are to be placed in the bottom of girders in the bridges, several ballast to be placed on top of them, filling the girders up even with the road bed.

An immense quantity of these big cement slabs will be manufactured during the coming summer. The work probably will be in progress during the entire summer. It is in charge of Stephen Butt. The cement used in the manufacture of the slabs will be stored in cars, and the finished product will be shipped out of Clinton as fast as it is turned out, and taken to various places on the system where new bridges are being constructed.

TARPAULINS VS. TEN CENT SACKS.

A lot of good money is wasted every year through the practice of using cement sacks to cover concrete. The sacks are frequently sprinkled with a hose in order to keep them moist and prevent the concrete from drying out. Sometimes, in freezing weather, concrete is covered with sacks upon which manure is piled in order to keep the concrete from freezing. The result is the sacks are destroyed. Such treatment, acting in conjunction with the cement dust with which the pores of the cloth are filled, causes them to rot so that they are no longer strong enough to make a proper package for cement. A rotten sack is worth much less than a torn sack because a sack which is slightly torn can be mended, whereas nothing will bring life and strength back to decayed cloth, says the Lehigh Portland Cement Company. The area of a cement sack spread out flat is about 3¼ square feet, so that the cost of covering concrete with 10 cent cement sacks is at least 3 cents a square foot. The price of tarpaulins ranges from 3½ cents to 9½ cents per square foot and a good, waterproof tarpaulin may be purchased for 6 cents per square foot. Therefore, if such a tarpaulin is bought and used twice, it has paid for itself as compared with the use of cement sacks for the same purpose; and there still remains a tarpaulin in first rate physical condition, capable of being used many more times as against the pile of rotten sacks which is all that is left after they have been misused in this way.

Wouldn't it be a good investment to lay in a few tarpaulins which may be used for other purposes besides covering concrete, and which will last and do good service for an indefinite length of time, rather than waste 10 cent cement sacks by putting them to a use for which they were never intended and which is almost certain to destroy them absolutely?

The Value of Competent Superintendence in Building Construction

The province of the building superintendent is to safeguard the owner against fraud and against waste of time and material. In speculative building work of moderate size the owner generally supervises. On large work the architect frequently superintends. One inspects and the other manages. Superintendence generally is paid for on a percentage basis, although some owners prefer to arrange for a flat charge for this work. Sometimes the general contractor superintends the operation and includes his charges in his bid for the whole job. In any case, competent superintendence rather than mere supervision of building construction is one of the most important factors tending toward success.

The cost of superintendence varies according to the size and character of the operation. It seldom exceeds 15 per cent of the cost of labor. Ten per cent, therefore, might be stated as fair average. This allowance will include the salaries of the foremen on large works. General contractors charge up the salaries of their general superintendents and office men, including office maintenance, to "general expenses," which are borne share and share alike by all the operations they happen to be handling at the time. Usually the share the individual operation must bear is not more than 4 per cent of the labor cost. As this usually comes out of the amount the contractor saves the builder, it will be seen that the hesitation on the part of many speculative builders in giving their construction work to general contractors, on the ground that they have to pay for their organization expenses, is not well founded.

A fair range of cost of superintendence on speculative operations may be stated as follows: The non-fire proof apartment house, not more than 3 per cent; on big office building contracts, from 4 to 8 per cent; on suburban speculative work, 1½ to 2 per cent. Upon counting up the saving on waste of time and material and through greater efficiency in workmanship, the builder will find that the employment of a competent superintendent is a profitable investment.

Most speculative builders, however, prefer to superintend their operations themselves. They employ the trade contract system because they believe they save the contractor's profits. Other reasons given by various builders are the belief that they get better workmanship, that they run less risk of law suits, that they obtain leeway of time for postponement work, if necessary, and that they may start work before the plans have actually been completed.

A contractor's profit is his recompense for his skilled services, nothing else. Hence, when a contractor is dispensed with there must be some one in his place to render the service of manager. As a general rule, the substitute is a person of meager knowledge of building, construction and tricky sub-contractors are often able to pull the wool over his eyes and are able to get away with it. The owner, therefore, stands to lose more than the cost of employing a good superintendent. It has been urged that a builder who employs a general contractor has to supervise the work anyway. This is not true, if he has employed a reputable company. Where the builder insists upon doing this he is paying twice for supervision.

When the builder has sub-contractors whom he can trust to the extent that he merely has to inspect the work done, it is not necessary to employ a superintendent or general contractor, but in most cases the speculative builder has to watch his supply men constantly, and he should have a competent manager to see that he is getting what he is paying for.

As for obtaining better workmanship, it would seem to stand to reason that a company having an organization of artisans trained in a particular line of work under a bonus system, something which many general contractors have adopted within recent years, would be able to obtain better workmanship than the casual employer of labor in the open market. It is also safe to assume that a company engaging skilled labor on one operation after another during the entire year would have the pick of the efficient workmen, all of which tends to disprove the contention of many speculative builders that the trade contract system is more profitable to them.

As to saving lawsuits, this is admittedly a well-founded contention. There is no question that law suits are avoided by getting along without a general contractor, but law suits of this kind are almost invariably the result either of ambiguous specifications or of changing plans without equitable provision for payment arising therefrom. The remedy is not the elimination of the general contractor, but the careful drawing of specifications and strict adherence to them unless an arrangement for compensation can be made with the contractors. It never pays to deviate from a written contract, whether the job is being handled by the owner himself or by having a general contractor.

As to the alleged advantage of beginning work before plans are completed, the best authorities deny this to be an advantage. The cost is liable to be increased unexpectedly and there is always danger of duplication.

The contractor is free to pay his superintendents according to his judgment of their worth, and all his employes according to the bonus system. A contractor almost invariably does his work at less expense for overhead charges than the individual builder can, and he can buy materials cheaper than the average purchaser because he is of known responsibility, whereas the speculative builder is an unknown quantity to the supply men as far as his resources are concerned.

To the average builder of a residence or a row of speculative buildings there is a certain charm in superintending his construction work. He takes pride in watching the creature of his imagination and of his plans grow into a finished form, but just as sure as pride goes before a fall, so is the inexperienced builder liable to come to grief because of lack of knowledge regarding the first rudiments of building construction. It is natural for him to feel that he is master, that his word is supreme; and because he insists upon standing upon what seemed to him to be his rights, he often finds himself confronted by a law suit or a disagreement with the laborers or sub-contractors that is costly and sometimes mortifying.

First of all, practical supervision is the exercise of common sense, coupled with diplomacy and a knowledge of building construction. No builder, superintendent or manager should give an order direct to any workman, except in times of greatest emergency.

The foreman in charge of each gang, whether it be plumbing, heating, carpentering, excavating or roofing, is the only person who should give an order. He is the officer in charge of the force, and neither superintendent nor owner should, intentionally or unintentionally degrade him in the eyes of his men by issuing orders over his head. This is one of the first and most important rules governing superintendence of building construction. Failure to observe it is responsible for more troubles with the labor unions and with sub-contractors than any other cause.

Do not use laborers to do the work of masons or carpenters, but provide a sufficient number of laborers to assist the skilled workmen. A 15-cent man can lift as many pounds of wood or stone as a 50-cent man. Exercise your wits in keeping each class of men busy at its particular class of work.

Keep the address of good workmen. This is most important, because one of the surest sources of minor loss which is liable to run into larger ones is to have to put an incompetent or poor workman in the place of a good artisan in case of injury or illness.

It never pays to be a "good fellow" with workmen, either in or outside of working hours. Once the respect of the men is lost, good workmanship can not be expected.

The best and cheapest insurance against accidents is care. Provide barricades, warning notices and red lights where street or sidewalk excavation or altering is being made. Even a small unprotected hole may result in a loss of life.

Keep outsiders off the premises, no matter whether they orally agree to enter at their own risk or not. When accidents occur to such persons, the courts may hold the builder responsible for negligence. Some builders carry this rule even to business agents of labor unions, but judgment must here be exercised by the builder or superintendent.

Superintendents should avoid all controversy with inspectors. Refer them in every case to the builder himself, and if an order is required, insist that it be in writing. Of course, where the superintendent is the builder himself, he will use his own judgment, but it is always best to treat inspectors, business agents, building department authorities and other officers of the law with tolerance. If they make unreasonable demands, do not hesitate to carry the matter up to their chief.—Record and Guide.

CUT IN CEMENT DUTY NO BENEFIT TO EAST.

Increase in Freight Rates Said to Offset It.

When the announcement was made by Canada that the duty on Portland cement imported into that country from the United States would be cut one-half during the summer months, owing to the inability of the Canadian trust to meet the demand, manufacturers in this section and the Lehigh Valley immediately saw an opportunity to get rid of some of their surplus stock at a profit, says the Wall Street Journal.

Investigation of present freight rates from the important distributing centers, however, disclosed the fact that within a comparatively short period the rates had advanced to such an extent that the reduction was of no value whatever. From Alsen, N. Y., where a large portion of the Portland cement made in that state is shipped, the rate within less than a year has advanced from $2.25 a ton to $3.60, an increase of over 50 per cent and equivalent to an advance of 30 cents on the barrel or 4 cents more than the Candian reduction of 26 cents.

Naturally the rate from New York to Montreal is better than from the Lehigh valley, and considering the fact that the rates from mills in that section have been also increased in proportion, the reduction in duty is practically useless so far as the east is concerned.

It is evident, however, that the west is better situated. They not only get a better price per barrel for their cement, but apparently there is no great difficulty to overcome through advances in freight rates. On the first day after the Canadian government had announced the reduction in duty it was estimated that western Canada placed orders through St. Paul for 1,000,000 barrels of cement.

SAND COMPANIES MERGED.

The three leading sand companies of Kansas City became a merger, the purpose avowed being to raise the price of Missouri river sand from 40 cents to 50 cents a yard and Kaw river sand from 60 cents to 75 cents a yard.

Now the dealers say they have not been making a reasonable margin on their sales to builders because of the war, so yesterday the Stewart-Peck Sand Company took over the Builders' Sand Company and the Kaw River Sand Company. The assets of the three companies is approximated at $175,000.

The sand companies operate under a government permit limiting them to certain districts, the only condition being that power boats be used and that the boats be not an obstruction to river traffic and be not tied to a pier, wharf or to the bank. The permit is granted without fee, but any number of sand companies upon application to the government can use the same territory.

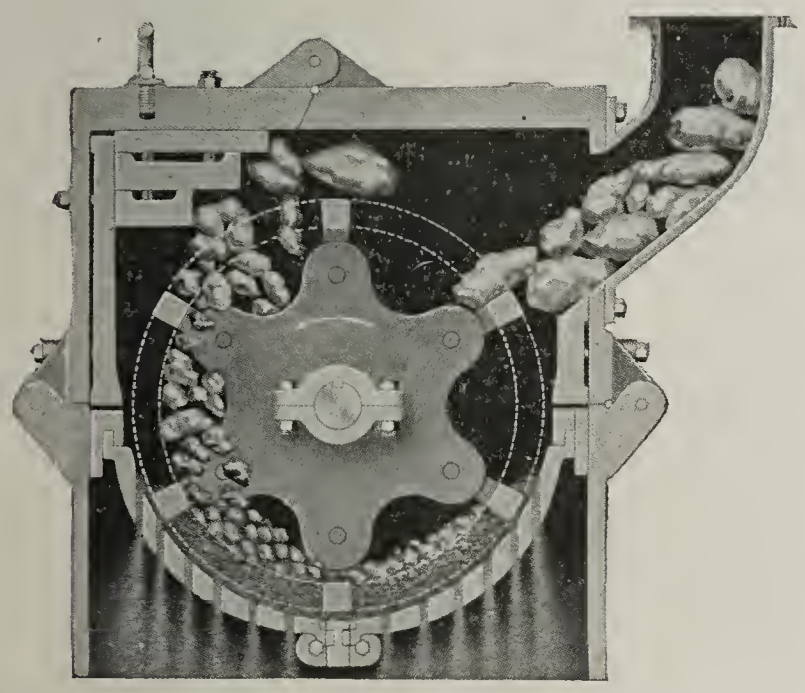
TESTS OF COLUMNS.

An Investigation of the Value of Concrete as Reinforcement for Structural Steel Columns, by Arthur N. Talbot and Arthur R. Lord, has just been issued as Bulletin No. 56 of the Engineering Experiment Station of the University of Illinois.

This bulletin gives an account of the investigation of the strength of a type of column which has been used recently in the construction of reinforced concrete buildings. Structural steel angles are tied together by bent plates, making a form known as the Gray column, and this steel structure is itself filled with concrete and covered with a shell of concrete for fireproofing purposes. Such a column requires less space than the ordinary reinforced concrete column. Whether in such a column the steel and the concrete act together to give a strong stiff column has been a matter of some doubt. In the investigation described, tests were made on unconcreted steel columns of various lengths to determine the strength of the steel columns and the effect of length upon strength. Tests were then made on similar columns filled with concrete. This enabled the action of the steel and of the concrete to be compared. The breaking loads were determined and the shortening of the concrete and of the steel was carefully measured. Tests were also made upon columns having a fireproofing shell and upon columns reinforced with spiral hooping. It was found that the column strength is approximately equal to the ultimate strength of the steel column of the same length plus the strength of a short concrete column of the same quality of concrete. For loads approaching the ultimate, the shell of fireproofing concrete clung to the column without spalling. The columns tested possessed the qualities of a good structural member and seem adapted to more general use in building construction.

THE GARDNER CRUSHER.

For grinding any material, either wet or dry, to any degree of fineness from 1 in. to 100 mesh, the Gardner Crusher Company, 346 West Thirty-fourth street, New York City, has placed on the market a combined crusher, disintegrator and pulverizer. The special feature claimed for this machine are the small driving power required in proportion to the output, and a special type of crank construction by which, if the material being crushed offers too much resistance, the beaters will turn on their axles, thus avoiding breakage. In many cases it is claimed that for certain materials the crusher is superior to one of the jaw type. When used in this way the Gardner crusher is operated as a single-stage reduction machine, and the material is fed directly from the quarry and reduced to the desired fineness in one operation without the use of any auxiliary equipment. This, however, is not recommended by the maker, as for very fine and regular grinding this crusher should be merely used in preliminary work before the material goes to the tube mill.



The machine consists of a very strong iron frame, cast in two parts, the lower one being the base and the upper one containing the hopper. The contact surfaces of both parts are planned to secure a perfect fit, while to prevent dust from entering, the top is fastened in place by bolts. In this way it is possible to inspect and clean the apparatus quickly by merely stopping it, removing the belt and lifting the top. The main shaft, which is located in the lower part of the frame, rests in two large bearings, that are provided with self-oiling lubricators. Mounted on this main shaft are two cheek plates, connected by articulated beaters, in the shape of brace cranks which are clearly shown in the lower part of the engraving. These beaters are made of high-grade manganese steel and are the only part of the apparatus subjected to wear. Their life depends upon the hardness of the material which they are employed to crush, and varies from one month to a year. The bottom of the crusher is a rounded, perforated iron plate, which acts as a screen for the material being discharged. Movable ribs of very hard metal are mounted on the inside of the top and can be moved down close to the cranks in case of wear, and also regulate the degree of fineness of the product. The material is fed into the crusher through the hopper placed at the left end, either by shovels or an automatic feeder, the latter not only improving the output of the mill, both as regards quality and fineness, but also lessening the amount of power required.

In operation the material passes through the hopper into the crusher, and one after another of the six cranks forming the crushing mechanism strike it rapidly in succession and break it into particles according to the degree of fineness required. The discharge is effected with great rapidity and the material is swept on the surface of the perforated grates in the lower portion, the combined action of the rotation thus imparted to it and the centrifugal force driving it out of the apparatus as quickly as the degree of fineness will permit.

The crusher can be mounted either on a bed of solid masonry or in a pit. In the latter case the bearing blocks for the main shaft rest on the side walls of the pit, which have the necessary strength to support them. When the product of the crusher falls into the pit, it can be removed either by a bucket conveyor, the lower end of which is placed under the discharge grate, or else by an endless belt running under the machine and receiving the crushed product directly. This latter method is recommended when several crushers are in operation.

Three sizes of crusher are made for handling material, the maximum dimensions of which are for the No. 1 machine 10x5 in., for the No. 2 machine 13x9 and No. 3 machine 14 x 12 in. A test made with very hard cement clinker in the No. 1 machine equipped with a screen having ⅛-in. holes gave an output of 6,000 lbs. per hour, 98 per cent. of which would pass through a 16-mesh sieve and 0 per cent. through a 100-mesh sieve. The same machine when equipped with a 1-16-in. screen and producing 4,000 lbs. per hour gave an output, 100 per cent. of which passed through a 16-mesh sieve and 70 per cent. through a 100-mesh sieve. Changes in the size of the output can be easily secured by changing the screen, whose only office is to regulate the fineness of the discharged material, and changing the speed.

POURED CONCRETE HOUSE.

One of the most modern and unique homes ever constructed has been built for Colonel W. F. Chantland at Virginia Highlands near Washington, D. C. It is a reproduction of the prize model designed by Architect Milton Dana Morrill and exhibited at the International Congress for the Prevention of Tuberculosis. The entire building is of poured concrete. The walls, floors, partitions, stairs and roof are all of concrete and to thoroughly clean, it is only necessary to remove the furniture and flush out each room with a hose. The floors of cement have a brush coating, giving a smooth finish of varying tints. The whole roof is utilized for living and sleeping in the open air.

CONCRETE ROADS.

The town of McLean, Ill., will pave the public square with concrete. This is the first town in the vicinity to adopt this type of pavement. The work will be done under the supervision of the Illinois State Highway Commission. The farmers near McLean have shown an unusual interest in the work and donated about $2,000 to help pay for it.

CONCRETE ON THE FARM.

Requirements for Sanitary Construction of Farm Buildings Make This a Most Useful Material.

Requirements for the sanitary construction of farm buildings make concrete and cement the most useful materials for floors and walls and even for roofs and ceilings. Most boards of health which undertake to regulate the production of milk sold under their jurisdiction require or advise the use of cement for floors in cow stables and specify also that the walls and ceilings must be tight, clean and free from dust-catching surfaces.

This evidently suggests the use of cement or hard plaster finishes. At present stables are usually built of wood, but concrete in block or cast in forms is being used more each year, and there is already a large number of barns scattered throughout the country which show in a highly developed way the best uses of concrete.

The fire-proof and permanent qualities of this material are powerful inducements of themselves towards its use. The ease with which it may be kept clean, the good health of the animals stabled in concrete buildings and the possibilitity of securing clean milk with a minimum of labor all increase the weight of argument in its behalf.

In floors, concrete shows practically no wear from use. It is water-tight, non-absorbent and sanitary and if sufficient bedding is used it makes a satisfactory material for animals to stand and lie upon.

Many farmers are prejudiced against a concrete floor. They think that it is cold, causing stiffness and rheumatism in stock. If sufficient bedding is used, this objection is removed. The good points of a concrete floor outweigh all supposed disadvantages.

Concrete partitions have been used between stalls both for cows and horses. Concrete in many forms is used for walls. The object to be attained is a hard, smooth wall surface, insulated as well as possible from changes of external temperature. It is, of course, not difficult to prevent moisture coming through the outside, but condensation of moisture inside is more difficult to avoid. Concrete block with air spaces, cored reinforced walls, and solid walls, with wood or metal and finished with plaster on metal lath, or lined with plastered partition tile or concrete block with a space between the two walls are means used for insulation. Dampness in a stable is very often a sign of poor ventilation.

The fact that concrete can be kept clean more easily than any other material in common use is its greatest recommendation for its use in farm buildings. The realization that health depends to a very great degree on cleanliness is as true for farm stock as it is for mankind. Good laboring help is difficult to obtain on most farms and anything that, like concrete, contributes to the reduction of labor necessary to keep the surroundings clean is bound to grow rapidly in favor on that score alone, especially since no valid objections to its use can be advanced in connection with stock or farm products.

A STRONG WAGON, YET LIGHT—A RARE COMBINATION.

The new model Aurora Dump Wagon has met with the hearty approval of contractors who have used or seen it. It has been a difficult problem to solve, to make a wagon of sufficient strength to stand the hard service required of it by contractors and yet light enough for one team to handle without distress. Wagons have been offered on the market of so flimsy construction that they would stand but a few months' service. In our new model we have embodied the essential requirements of strength and lightness. In construction of the bed, Washington fir of the best grade is used. This wood has the same strength as oak with much less weight, so that it is ideal for use in wagon construction.

Special attention is invited to the door hinges, the construction of which will be noted in the illustration. A slot is provided for vertical play of the hinge pin, which gives flexibility to the door and prevents it from binding on the dumped load.

No surplus material is used in building this wagon, but each part is made of proper weight and material for the purpose for which it is designed and it is believed that the wagon as now constructed is practically perfect. Hundreds of them are in use and they are recognized as possessing a combination of superior qualities which make them more desirable than any other wagons on the market. They are cordially recommended for either grader or hand work. This wagon is made by the Western Wheeled Scraper Co., Aurora, Ill.

CEMENT TRADE PERIODICALS MERGE.

Announcement was made June 1st of the consolidation of Cement Age of New York and Concrete of Detroit, both monthly periodicals. A third publication, Concrete Engineering, published in Cleveland, was recently combined with Cement Age, so the new merger is practically made up of the three publications. The first issue of the new monthly, which will be known as Concrete-Cement Age, will be made in July. The publication office will be in Detroit, with branches in New York and Chicago, and a new corporation capitalized at $150,000 will be formed to take over the properties.

CONCRETE SIDEWALKS.

The Universal Portland Cement Co., Chicago, Ill., has issued the fifth edition of the book, "Cement Sidewalks." This is a comprehensive and instructive treatment of the correct methods of laying concrete walks and has been in very wide demand. Copies are sent out by the Company free of charge.

Gypsum Plaster on Metal Lath

Objections are often met with to the use of gypsum plaster in contact with metal lath or steel. These objections when inquired into are usually found to be based upon prejudice alone, but objections are sometimes met with based upon isolated cases where the iron or steel lath in contact with gypsum plaster has been corroded. In these cases the observers, viewing the particular cases in a superficial manner and taking no cognizance of any other factors, have jumped to the conclusion that gypsum plaster has a particularly bad effect upon steel or iron. Curiously enough, such conclusions are not arrived at when metal lath is found corroded when plastered with lime or Portland cement mortar. Why this discrimination against gypsum?

A brief presentation of this subject in your columns for the benefit of your readers seems entirely opportune because the same misconception has been given expression in the suggested specifications for "Stucco on Metal Lath," by H. B. McMaster, which appeared in your March issue.

This suggested specification, having back of it the weight of the influence of the Associated Metal Lath Manufacturers, may tend to confuse and implant uneasiness in the minds of some building material dealers who sell to their trade both metal lath and calcined gypsum or hard wall mortar.

Unfortunately, Mr. McMaster has left the impression, doubtless without intention, that calcined gypsum plaster is unsuitable when placed upon metal lath, either for exterior or interior work, although presumably the intention was to recommend specifications dealing entirely with exterior work.

It is not disputed by any competent observers that calcined gypsum plaster should not be used upon metal lath universally and everywhere for exterior work. Unfortunately, it is hard to distinguish in general specifications between the behavior of different materials under different conditions of climate, humidity of atmosphere, etc., and for this reason the recommendation for the use of calcined gypsum plaster upon metal lath for exterior work is invariably withheld, although experience in dry climates has shown no objection whatever to its use.

The writer, believing that the question of corrosion of metal was a question of the access to the metal of damp air and was wholly irrespective of the character of plastering material used, whether Portland cement, lime, or cement and lime mixed plasters, or gypsum plaster, about two years ago conducted a country-wide investigation into this subject to learn the actual behavior of metal laths when used for exteriors and when covered with different kinds of plasters.

The investigation disclosed the fact that in damp locations particularly on the sea coast and in the Mississippi Valley that the corrosion of the metal lath was relatively great, and that this condition was irrespective of what kind of plaster had been used. On the other hand, in higher altitudes and drier parts of the country, the corrosion of the metal lath was practically nil, also irrespective of the kind of plaster used.

This investigation was made entirely upon the behavior of metal lath when used as a lathing base for exterior plaster work, and the observations included ingot iron, unpainted lath, painted steel lath, galvanized lath and also plasters of different compositions, including Portland cement and gypsum.

Isolated experiments covering periods of time running into the years, in dry and damp locations, have been made upon metal laths of different types, gauges and composition of metal, from low carbon irons to the high carbon steels and with different kinds of protection when covered with gypsum plasters.

These experiments have clearly confirmed the above conclusions and show that the question of preventing corrosion is a question of keeping damp air from coming into contact with the iron or steel, irrespective of whether Portland cement, lime or gypsum plasters are used.

As pointed out above, the suggested specifications for "Stucco on Metal Lath," offered by Mr. McMaster as the recommendation of the Associated Metal Lath Manufacturers, are confusing because they seem to indicate that calcined gypsum or hard wall plasters should not be used anywhere, either outside or inside of a building, when in contact with metal lath, and in the interest of truth and justice this erroneous impression should be corrected. There is no question whatever that gypsum or hard wall plasters have been successfully used for interior work, where the construction is dry, in contact with metal lath.

It seems to be a reasonable requirement to make of the manufacturers of metal lath that they should protect their metal lath by coatings that would prevent the access of damp air to the iron and steel.

That the protection of many metal laths is insufficient seems to be recognized by Mr. McMaster in the specifications referred to because quoting from his specifications, he says: "Care should be taken not to expose the lath to the weather while it is lying about the building." Again he says: "The lath shall be painted to protect it until it can be applied and covered with Portland cement plaster." He further seems to recognize that metal lath should be kept from moisture, even when covered by Portland cement, because in speaking of exterior work, he states, "Lath and plaster should not be carried all the way down to the ground," evidently desiring in this way to protect the lath from ground moisture.

The writer of this article entirely concurs with the suggested specifications in the suggestion that the metal lath should be entirely embedded in plaster, although he does not concur in the suggestion that this should be Portland cement mortar and only Portland cement mortar.

The writer has in mind a sample of naked metal lath that was embedded in gypsum plaster and allowed to remain in a damp location for two and a half years. A critical examination of this sample showed that where the metal was entirely embedded no corrosion occurred, but that where the damp air was able to have access to the metal, corrosion did occur.

It is very unfortunate, in considering this subject, that there is so much misunderstanding as to the exact meaning of the word "stucco." Originally and even today the word "stucco" indicates that the material is composed of plaster of paris. A transition from this definition to a meaning embracing all character of plastering on exterior surfaces seems to have taken place, and Mr. McMaster in his views seems to have this thought, although it is distinctly confusing when many people believe "stucco" to be plaster of paris, others Portland cement, and still others any plaster when used for exterior work.—The Dealers' Record.

HAND AND MACHINE MIXED CONCRETE.

Referring to the article on page 128 of your May (1912) issue, regarding hand and machine mixed concrete by the Waterloo Cement Machinery Company, writes De Witt V. Moore of Indianapolis: I beg to acknowledge receipt of criticism of the Waterloo Cement Machine Corporation on the subject, "When hand mixing is justified," a sub-head under my paper "Practical Concrete Construction." It is hardly probable that the Waterloo Cement Machine Corporation and the writer could ever expect to absolutely agree on the subject of the cost of concrete mixing. It must not be overlooked that no matter how good a mixer "The Little Wonder" the Machine Company necessarily in their advertising and correspondence will take the most favorable view of the cost of machine mixing. On the other hand, the writer is an Engineer and Contractor, and will necessarily take into consideration a great many features which will be overlooked by the Machine Company. Conditions, circumstances and the location of the work, the accessibility of same, the delay to the installation of Mixer, the building of scaffolding, runways, etc., all have an influence, and while perhaps not expressed explicitly, is at least understood when hand mixing is mentioned as being preferable.

Referring to comparison of cost furnished by the Waterloo Cement Corporation we desire to be understood that we are not referring to cement finishers, but rather to concrete work, which employs the use of common labor. We, therefore, criticise the estimate furnished by the Waterloo Company, stating that the average of wage should not exceed 30 cents per hour. However, this is of minor importance in the comparison, as the rate of pay may be considered the same by both hand mixing and machine mixing, therefore, it makes no difference what the rate of pay, nor will the writer quarrel with the Waterloo Company as to their statement of rated capacity of hand work and machine work. It would seem that the practical end of the proposition is entirely missing.

Many times machine concerns advertise their product in the machine line by stating those labor conditions which surround the operation of the machinery alone, which is manifestly unfair when considered from the cost of the work in place. In mentioning "Hand Mixing" the writer was of the opinion that he was addressing a class of experienced men who would understand that the cost figures mentioned were intended to include installation, preparation, building of runways, scaffolding, etc., all of which are and should be included as a proper charge per yard of concrete with reference to the particular and individual job.

With this understanding the writer does not for one moment intend to convey the idea that concrete can be mixed as cheaply when "Done by Hand," as when "Mixed by Machine," but, if it is a small job and the machine must be hauled to the job and installed and runways constructed in order to bring the raw material to the Mixer, and then handle the finished concrete from the Mixer, when by "Hand Mixing" the entire operation can be done practically upon the site of the work, without such preliminaries, then "Hand Mixing" is desirable.

Suppose we have a job of placing walls and basement floors in a building consisting of not more than 200 yards, we will leave it to the average contractor how soon it would take to exhaust $100 in preliminary work of installation of Mixer, building of runways, etc., to reach each and every part of the building, especially if the building is in a congested district of a city. Such a preliminary cost is just as true a cost per cubic yard as the actual cost of mixing.

It would seem that the Waterloo Company have read the letter of the article rather than the spirit in their comments as set forth.

THE MEASUREMENT OF CRUSHED STONE.

It has been found that the measurement of wagon loads of broken stone after loading from chutes and again after it has been hauled a half mile or more, shows a shaking down, or settling, resulting in an average reduction in volume of about ten per cent.

Therefore, if crushed stone for macadam or ballast is purchased by the cubic yard, it is necessary that it be stated where the measurement is to be taken.

In buying stone for concrete, it is equally necessary that there be a clear understanding as to how the size of the stone is to be measured.

If the specification requires that the largest permissible stone shall pass in **every direction** through a ring, say 2½ ins. in diameter, it means that the opening of the screen must be considerably smaller than 2½ inches, for the reason that in screening stone in a rotary screen, long narrow fragments will drop through a 2½ inch hole, yet many of these will not pass in every direction through a 2½ inch hole.

There are two ways of designating the size of stone after screening. One is to designate it according to the diameter of the screen hole through which it passed. Another very common way is to designate it by the "average size" of the stone. The latter is obtained by taking the diameter of the screen hole through which **the stone did pass,** adding to it the diameter of the hole through which it **did not** pass and dividing the sum by two.

For example, suppose a stone crusher plant were provided with a rotary screen having three sections of perforated metal, the holes of the first section being ¾-in. diameter, the holes of the second being 1½-in. and in the third section 2½-in. Then assuming that the stone that passes a ¾-in. hole runs from dust to ¾-in., the average size would be ⅜-in. The average size of stone that passes the one and one-half inch hole but does not pass the ¾-in. holes is $(1\frac{1}{2} + \frac{3}{4}) \div 2$, or 1⅛ inch, and it may be called 1⅛-in. stone. In like manner, the stone between 1½-in. and 2½-in. may be called 2-in. stone. This rule, however, is not strictly followed by manufacturers of crushed stone, so that it is always necessary to inquire exactly what they mean when speaking of stone of a certain size.

TO PUT IN NEW GRAVEL LOADING DEVICE.

W. H. Hunt, of Galt, Illinois, who is in the gravel and sand business and loads cars to be shipped to various parts of the country, says that the business is on the increase and must resort to other means than the man and shovel in handling the material. He is now loading a car a day with four men and two teams and with the machinery he is figuring on placing in his pit he can load three cars a day with two men and one team. A side track will be built from the C. & N. W. right of way to the pit and a gasoline elevator will be used to fill a dump bottom car which will be used to convey the material to an elevation higher than the cars and dumped into a chute leading to the car. A team and scraper will be used to fill the elevator at the pit. The conveying car will hold two yards and will be handled with a team.

SAND LIME BRICK CO.

The Acme Brick and Sand Company of Milwaukee has been incorporated with a capital stock of $200,000 by P. G. Toepfer, I. G. Toepfer and Charles J. Pokorny. The new concern has purchased a brick plant northeast of West Bend, Wis., about thirty miles from Milwaukee, and now has the establishment in full operation. William Modes is superintendent and B. Lee Blanchard is sales manager, both of whom will be located at West Bend, while the main offices of the company are located at 193 Broadway, Milwaukee. Officials of the company claim that they are building a brick superior to anything that has been manufactured before, using a caustic lime that was formerly used at the West Bend plant.

SAND AND CEMENT TO BE USED IN BIG DAM

Blend of Material Is Expected to Effect a Saving of More Than $250,000.

The Reclamation Service is preparing to install a plant for the blending of sand and cement at Arrowrock, Idaho. This plant will have a daily output of 1,000 barrels of 40 per cent blend sand cement and will cost approximately $40,000. The product will be utilized in the construction of the Arrowrock dam, which is to be the highest masonry dam in the world, says the Builder and Contractor.

This enormous structure, which will be 351 feet in height, will require 500,000 barrels of cement, and the engineers estimate that the use of the blended sand and cement will effect a saving of more than $250,000 in the cost of the dam. Experiments in the dilution of cement with extremely fine ground silica, notably on the Los Angeles aqueduct have shown that great economy can be effected in concrete construction. On the aqueduct work the cement is being reground with volcanic rock, the latter comprising from 60 to 70 per cent of the whole. This mixture is being used in the usual way in making concrete and is standing all the tests as to strength and other qualities.

At the Arrowrock site there is an abundance of granite, which will make a first class blending material, the use of which it is believed will result in great saving in the cost of cement. This is not the first experiment in manufacturing by the Reclamation Service. Among its numerous ventures it will be remembered that a cement mill was established at the Roosevelt dam in Arizona, which turned out 340,000 barrels of first class cement at a net saving of $615,000 over the lowest bid from private manufacturers. The building of the highest dam in the world necessarily presents many important problems calling for initiation and inventive genius. At the present time the engineers are operating a standard gauge railroad with daily freight, mail and passenger service, a large electric power plant, machine shops, merchandise stores, water works, and a huge commissary to care for more than 1,200 employes.

County Bridge of Concrete.
Allegheny County, Pa.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.

The session of the Association of American Portland Cement Manufacturers at the Hotel La Salle, Chicago, on May 9, was devoted entirely to the subject of good roads and the use of concrete in road construction. The speakers were Mr. Logan Waller Page, Director, Office of Public Roads, Washington, D. C., Wm. M. Pindell, President, Dolarway Paving Co., New York City; W. P. Blair, Secretary National Paving Brick Manufacturers' Association, Cleveland, Ohio; Edward N. Hines, Road Commissioner Wayne County, Detroit, Mich., and J. S. McCullough, City Engineer Fond Du Lac, Wis.

After the conclusion of the program a special train was chartered and the entire party went to Ann Arbor and Detroit on an inspecting tour of the concrete road work in and near those cities. At Ann Arbor, City Engineer Groves conducted the party on an automobile trip over all the pavements which have been built under his direction. At Detroit the Wayne County roads were inspected under the guidance of Commissioner Edward N. Hines. In the evening the entire party were the guests of Edward M. Hagar, President of the Association at dinner at the Hotel Ponchartrain. Every one in the party expressed the highest opinion of the wonderful progress in road building of concrete as revealed by the work at Ann Arbor and Detroit. All were convinced that these pavements were satisfactory in every respect and were converted into enthusiastic advocates of concrete roads.

CONCRETE TIES TAKING PLACE OF WOOD SUPPORTS.

Appalled by the rapid and continuous advance in the price of ties and the dwindling supply of timber suitable for their manufacture, the Pennsylvania, several years since, instituted a forestry department, planting many thousands of trees upon land either then owned by it or acquired subsequently. At the same time the management made it known unofficially that the time had arrived to begin making provision for the future, the fact being indisputable that the tie timber of the country, even with the wisest conservatism of the resources then available and to be provided, would be so depleted within a comparatively few years as to make the cost of timber virtually prohibitive. Meantime, the Pennsylvania has been experimenting with manufactured ties of various kinds as well.

During the year ending December 31, 1910, the system used 5,666,322 ties in making renewals, at a cost ranging from 85 cents to $1 each, an appreciable increase, both in number and cost over the figures for similar periods. In the circumstances the management, seeking a substitute for wood, has been trying out a patented concrete tie, the general dimensions of which follow closely the systems standard for timber ties, namely, eight feet six inches over all, with a width, or bearing surface upon the ballast, of eight inches and with a maximum height from the base of the tie to the highest point, which are the edges of the spaces left to receive the rails, of 10¾ inches. The distance from the end of the tie to the edge of the space in which the rail sets is 17¾ inches. The width of the rail space is 8½ inches, while the remaining distance between the inside edges is 4 feet 2½ inches.

The chief difference between the concrete tie and a regular wooden tie is, first, the provision by which the rails are to be set into the tie so that only the heads of the rails protrude above its finished surface; the tapering of the tie beyond the outside edge of the rail toward the end of the tie so that its thickness is decreased from 10 inches to 4 inches and, finally, the tapering of the tie in the center, giving it a minimum thickness of 6 inches. The purpose of the departure from the ordinary shape used for wooden ties is interesting. It is believed that the tapering of the end of the tie beyond the rails makes a more symmetrical roadbed, decreases to some degree the shoulder of ballast ordinarily required at this point, decreases the weight of the tie and reduces the likelihood of having any obstruction catch in the track and derail or damage the equipment. The tie is tapered in the middle, not only in order to save material and added expense, but also weight increasing the ease of handling. In addition it will be noticed that the bottom of the tie between the centers of the rails is slightly concave, the center being an inch higher than the points immediately under the rail.

This is designed to overcome, if possible, the tendency of ballast to work out from under the rails, leaving the track suspended upon a solid pile of ballast under the middle of the tie. This springing of the ties over the ballast in the middle as the train passes along is very hard on both ties, rails and equipment. It is believed that by slightly concaving the tie the tendency of the ballast to creep will be materially reduced and that a steadier roadbed will thereby be secured. The hollowing out of the tie on the top to a maximum of 3 inches decreases the amount of ballast required in the middle of the track and cuts down the likelihood of damage because of water scoops or other objects hanging below the equipment.

CONCRETE SILOS ADVISED.

Silos and silage come in for much attention at the Twenty-Sixth Annual Wisconsin State Farmers' Institute round-up last March at Neenah, Wis. Discussion of silos and silage was in charge of John Imrie of Roberts, who advised unreservedly in favor of concrete silos. Wooden silos, he stated, are satisfactory while they last, and their term of usefulness may be from eight to twenty years. They are, however, he said, more expensive than concrete silos, considered even from a standpoint of first cost. They are necessarily comparatively short lived, while a concrete silo, properly constructed, will last indefinitely. The concrete solid wall is cheapest of all, according to Mr. Imrie, and its utility has been proved beyond all question. Frozen silage will be found in all silos with a solid wall. The location of the silos is more important with regard to freezing than the structural material. Locating the silo on the south or east side of the barn will do more toward protecting the contents from freezing than any difference in building materials.

Mr. Imrie advises against ever leaving silage sticking to the walls of the silo, but said rather that the silage should be kept several inches lower about the walls than in the center, and when this is done little trouble will be experienced from freezing. Some Wisconsin farmers have found that by connecting the barn ventilator with the outer air through the silo, so that the heat from the barn is conducted over the silage, no trouble from freezing will be experienced.

The walls of the silo must be smooth and the concrete well reinforced. Solid concrete silos, properly constructed, are fireproof, and the insurance rate is only a small fraction of that for wooden silos. No silage will spoil in a concrete structure if the walls are waterproof. To insure this, Mr. Imrie advises coating the inside of the structure with a mixture of pure cement and water. This should be put on after first dampening the walls, and a second coat should be put on after the first is dry.

The cement coat closes the pores of the concrete, effectually preventing any change in the moisture contents of the silage, and also preventing any action of acids on the concrete. It was advised that relatively small silos are preferable to large ones. Fourteen feet in diameter and 50 feet high is better for the average farmer than one 16 feet in diameter and only 40 feet high.

Patented forms for making solid wall concrete silos are now being placed on the market by the New Enterprise Concrete Machinery Co., 15[illegible] W. Randolph St., Chicago. Write them for their latest catalogue.

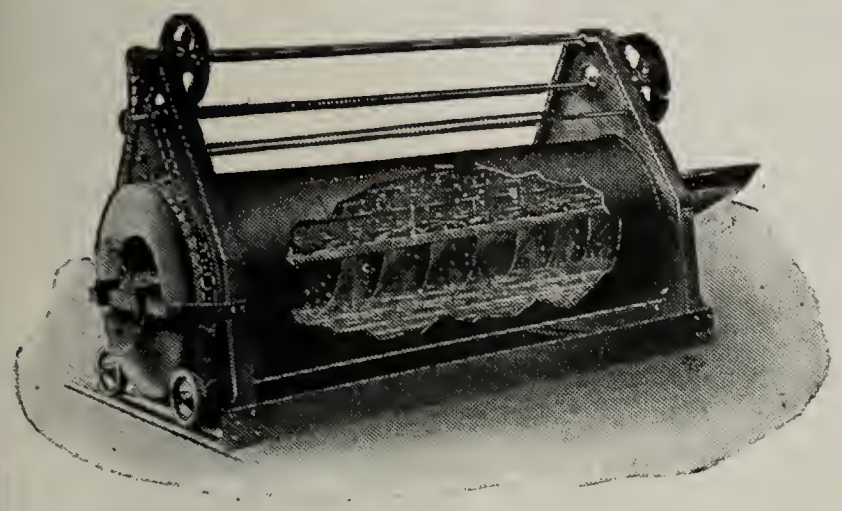
CONCRETE SILOS.

The possibilities of the concrete silo have been seen by the Wilbur Lumber Co., McHenry, Ill. A Polk, Genung & Polk silo outfit has been purchased by this company, who are soliciting orders from several farmers for concrete silos. The Wilbur Lumber Co. secured three orders as soon as they purchased the Polk forms and have much business in prospect. Cement dealers in agricultural districts and small town contractors can gather a rich harvest by developing this business in their communities.

CEMENT SIDEWALK BOOK FREE.

A 50c hand-book on cement sidewalk construction will be sent free to any of our readers by the Ubbink Steel Form Co., 215 Pier st., Port Washington, Wis. It contains about 50 pages of reading matter and is finely illustrated.

Good Concrete Work Demands Good Materials



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The machine which is guaranteed to remove all impurities which are soluble in or which will float on water.

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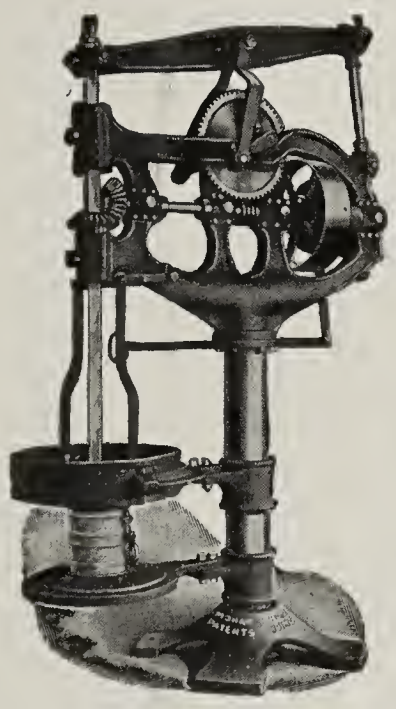

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on the same basis—its earning capacity. A strictly modern machine, built for service; every feature designed to save time.

We have recently made some exceptionally valuable improvements in Jacket Fronts, Packer Heads and Pallets.

Ask about our Improved Jackets. Full Line Cement Working Machines.

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FOR ALL PURPOSES

All Lengths Wire Ties Manufactured for Tying Reinforcing Rods

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THE MANUFACTURE OF CEMENT SEWER PIPE IN BROOKLYN.

There are about 400 miles of cement sewer pipe in Brooklyn, N. Y., a large part of it made by the Wilson & Baillie Manufacturing Co., of that borough, by means which Mr. Gustave Kaufman described substantially as follows in a paper before the recent convention of the National Association of Cement Users at Kansas City. The pipe is made in 6, 9, 12, 15, 18 and 24-in. sizes, the 6-in. and 9-in. being plain round pipe and the others of equivalent capacities to the round pipe of the same diameter. They are 3 ft. in length, with hub joints, with the exception of the 6 in. which is 2 ft. 3 in. The 12-in. pipe is round, with a flat base, and the 15, 18 and 24-in. pipe are egg-shaped, with flat bases. The thickness of the walls ranges from ¾ in. for a 6-in. pipe to 2 in. for a 24-in. pipe; while the collars have a corresponding variation, ranging from a depth of 1 5-16 in. and a ⅛-in. joint for a 6-in. collar, to a depth of 1¾ in., and a ¼-in. joint for a 24-in. collar.

Pipe making by machine was introduced by The Wilson & Baillie Manufacturing Company. The cement, sand and trap rock are measured and thoroughly mixed in the machine, evenly fed to the molds, and rammed mechanically with iron rammers regulated to produce continuous and uniform blows of any impact desired.

The machine consists of a mechanical tamper and a revolving table upon which the molds are placed. The tampers have a vertical reciprocating motion and at the same time move outward and inward rapidly so as to conform to the line of the travel of the mold, which, owing to its oval form, presents varying diameters at each revolution to the successive tamping bars. There are eight tool steel tampers, each making 200 strokes per min. Only one is down at a time. The head, which consists of the actuating machinery for the tampers, is counter-balanced upwards as the mold is being filled with concrete. The head is raised by the density of the concrete and, in this way, an even and regular product is obtained, Mr. Kaufman said. The force of the blow of each rammer is estimated at 800 lb. The area of the arm of the rammer is about 1 sq. in.

The proportions used in latter years are 1½ parts of the best Portland cement, 1 part of sand and 3 parts of trap rock screenings, containing 20 per cent. of stone dust. The percentage of water used to the whole bulk varies from 10 to 15 per cent., according to the condition of the ballast. The mix, when dumped on the floor, is apparently dry, but will ball in the hand with some pressure. An extra mix is used in forming the collar for the reason that as the rammers do not exert a direct blow on the material in the offset, compression of the material must be depended upon.

The mixed concrete is delivered to the machines in barrows and is fed into the hoppers by two men, one on either side. As soon as the flask is full and the core automatically lifted clear, the flash is taken up by a pipe truck and wheeled into the stripping rooms where it is allowed to stand usually 30 min., when it is stripped. After the pipes have set over night a spray of water is turned on and the pipe kept damp for six days, when they are removed from under cover and placed in the yard. The pipes at the expiration of 30 days, are set sufficiently to be handled in the work.

Spurs for house connections are connected on the pipe. A hole is cut at the proper point on the side of the pipe and a mold is placed in the interior. Cement mortar is then spread over the mold and the connection piece is bedded in place and a heavy band of mortar is wrapped around the joint on the outside. After the mortar is removed the inside joint is finished with a trowel.

TESTS ON REINFORCED COLUMNS.

The results of an extensive series of tests of the strength and elastic properties of concrete columns reinforced with spirals and longitudinal rods, conducted by Prof. M. O. Withey, assistant professor of mechanics in the university laboratory for testing materials, are contained in Bulletin 466, University of Wisconsin, Engineering Series, Vol. 7, No. 1, just issued. The tests were made from a rather comprehensive point of view, no less than seven elements being thoroughly investigated; to do this, sixty-columns of commercial size were tested. The findings, which in most cases are noteworthy, briefly comprise the following:

1. With respect to varying the richness of the mixture, the fact was developed that rich mixtures are more economical than lean ones, provided materials can be obtained at average prices. It was found that more economical mixtures are produced when the proportion of cement to aggregate, by weight, lies between 0.2 and 0.7.

2. With reference to the effect of varying the percentage of spiral reinforcement, the tests showed that although the yield point is practically independent of the spiral reinforcement, the ultimate strength and toughness are directly affected by it; one per cent. of closely-spaced spiral of high carbon steel was shown to be sufficient for lateral reinforcement.

3. As to varying the percentage of longitudinal reinforcement, it developed that the addition of longitudinal steel can be made to considerably increase the yield point, ultimate strength and stiffness. As, however, cement is ordinarily a more economical reinforcement than steel, it does not seem advantageous to use in combination with a rich concrete, more than two or three per cent. of longitudinal steel.

4. In regard to the effect of repeated or time loadings, no definite conclusion was reached, although the results plainly indicate that there is practically no increase in set or deformation after a few repetitions of loads equal to 40 to 50 per cent. of the yield point.

5. With respect to columns eccentrically loaded, the close agreement between the values derived from the tests and the theoretical values shows that common formula

$$S = \frac{P}{A} = \frac{Mc}{I}$$

for short homogeneous columns eccentrically loaded, is applicable to reinforced concrete columns.

6. As to the effect of differences in end conditions, that is, the bearing surfaces, the tests disclosed that the strength of a column will be about as great when resting on a footing as when bedded on a metal plate, provided the base is properly reinforced.

7. With reference to the relative value of plain and deformed bars for longitudinal reinforcement, the results with the use of corrugated bars of high carbon steel were so uniform and the strengths so high that this type deserves much consideration. The use of deformed bars of high elastic limit was shown to be more economical, with certain ratios of unit prices, than plain round bars of mild steel.

The bulletin contains a very complete bibliography of published matter on the subject of testing reinforced concrete columns.

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Load every bore hole in your quarries with the Du Pont Explosive best suited to shatter, rend or heave the largest quantity at the least cost for material, time and labor.

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Our "High Explosives" catalog describes the qualities of each Du Pont Explosive adapted to quarrying. Send for it today. Read it and follow the suggestions made by manufacturers of explosives whose practical knowledge makes them an authority on the choice and use of explosives for quarrymen. *Address Dept. 112.*

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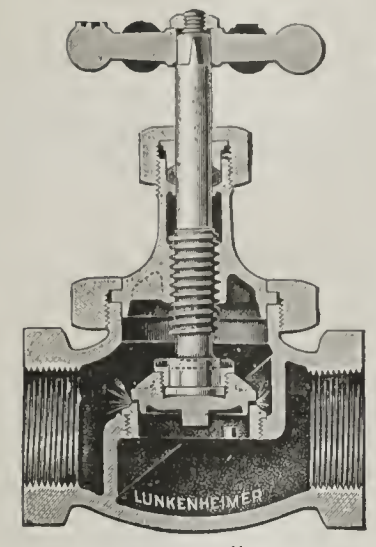

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Let the purchase of your valves be governed by "QUALITY," carefully consider durability and practicability; compare the "Renewo" with other makes of valves, and we feel satisfied as to your choice.

Lunkenheimer "Renewo" Valves are durable, not only because **all parts, including the seat and disc are renewable,** but owing to the scientific construction of the seat and disc, the **wear on the seating faces is reduced to a minimum,** and **these faces are self-cleaning.**

The seating faces are regrindable without removing the valves from their connecting pipes.

The material used for the body and trimmings, is of the very highest grade, the bronze containing a large percentage of copper and tin. **The seat and disc are made of a most durable nickel alloy.**

The valves are made in **Medium** and **Extra Heavy** Patterns, guaranteed for working pressures up to 200 and 300 pounds per square inch respectively, and in sizes ranging from ¼ to 3 inches inclusive.

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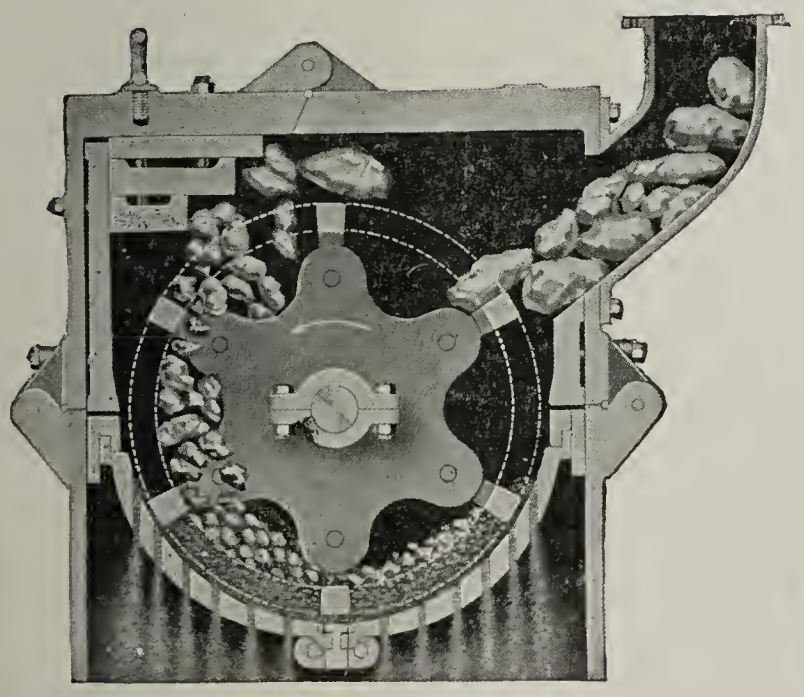

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Low Motive Power
Any Desired Fineness
Strong Construction
Moderate Prices

The best machine on the market for reducing material from 3-in. to 20 mesh and under in one operation.

We make this machine with capacities ranging from 50 pounds to 50 tons per hour.

You will be interested by our new catalogue No. 3

GARDNER CRUSHER COMPANY

546 West 34th Street **NEW YORK CITY, U. S. A.**

SOME POINTERS ON GRAVEL WASHING PLANTS.

Every careful business man before investing in a gravel plant will first thoroughly post himself in all phases of the business. In order that the main points may be considered, we suggest the following.

Things to Investigate.

1. Be sure you have the gravel.
2. Be sure you have the market.
3. Be sure you have good railroad facilities and freight rates.
4. Learn the kinds of product your market requires and arrange to furnish the demand. In hardly two places in the country are the requirements the same.
5. Learn the probable demands of the market in yards per day and arrange the capacity of your plant accordingly.
6. Consider the prospect for future demands and arrange for a possible future increase in capacity.
7. Investigate the concern of whom you plan to buy the equipment. What is their record of successful plants? What is their financial standing? Have they the experience and the engineering ability necessary to design a successful plant? Do they manufacture all the equipment? Will they be in business five years from now?

Things to Avoid.

1. Don't buy your plant from a company that has had little or no experience in the design of gravel washing plants, and then expect to get a first-class, profitable plant.
2. Don't buy your plant from "scalpers" where the transmission equipment may be purchased from one concern, the conveyors from another, the screens from one or two others, etc. You may need extensions and repairs.
3. Don't buy from a company that "borrows" a plan and through lack of experience thinks they "are all alike."

The conditions are never the same in two places, and the design must be made to suit the exact conditions it is to meet. No "stock-plan" gravel plant has ever been successful.

4. Don't buy from irresponsible concerns with poor financial standing.

The Link Belt Company, Chicago and Philadelphia, have studied the washing of gravel for many years. They have designed and erected a great many commercially successful plants, in all parts of the country, operating under every possible condition. Their experience thus gained is used in the design of every new plant.

They have first-class engineers in their organization who have made a special study of sand and gravel products. When you submit your conditions to them and tell them what you'd like to do, you get the benefit of all the knowledge and experience of this organization.

Their plants are designed so as to provide for future increases in capacity at the least possible expense. Many plants that have been built within the past few years have been doubled in capacity since they were first installed.

They manufacture the complete equipment for washing plants and consequently give the best service on renewals and repairs.

NEW $1,500,000 PASENGER STEAMER.

The Detroit III, the largest side-wheel passenger steamer in the world, the latest addition to the already unexcelled fleet of the Detroit & Cleveland Navigation Company, marks the epoch of finality in shipbuilder's art and skill.

In construction of the new City of Detroit III nothing that money could buy has been omitted in an effort to make the ship the most modern model of shipbuilding skill, combining staunchness of build with the latest approved types of mechanical equipment and every essential to the comfort and care of passengers, with palatial furnishings, fittings and decorations.

Marconi Wireless System in communication with shore and other vessels at all times while under way; Life Boats and Life Rafts sufficient for all regular passengers, 4,200 Life Preservers, Automatic Sprinkling System, Thermostat Fire Alarm System, direct to Captain, Chief Engineer and Purser indicating exact location. Two Fire Walls, Asbestos and Galvanized Iron Lining in linen room, store room and an overhead freight deck, Double Bottom, Eleven Water Tight Compartments, etc.

On the Buffalo Division.

Steamer City of Detroit III will be operated between Detroit and Buffalo from June 10 to September 10, in connection with Steamer City of Cleveland III. The carrying capacity of Steamer City of Detroit III is 5,000 and the Steamer City of Cleveland III 4,000, which insures first-class service and accommodations during the busy season.

CRUSHED STONE NEWS.

The White Lime Quarry Company is shipping 150 tons of limestone daily from its quarry at Doremus, Utah. This is used for fluxing purposes, its quality being specially fitted for this. A quarry face of 30 feet has been developed and this is being doubled so as to give an output of 400 tons a day. L. I. Hammond is president of the company.

A monster blast was set off recently in the quarries of the Potomac Valley Stone and Lime Company, at Hagerstown, Md. Fifteen holes were drilled deep into the rock and 4,600 pounds of 60 per cent. gelatin dynamite were fired. This threw down into the quarry about 50,000 tons of stone and earth.

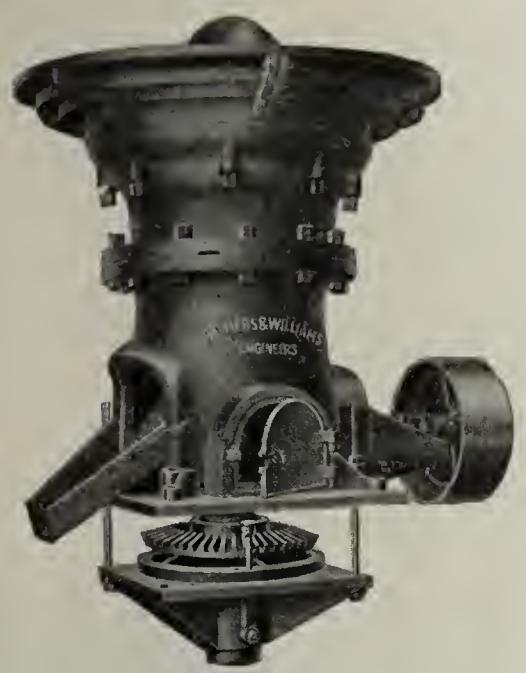
The city of Milwaukee has made a contract for 38,000 cubic feet of crushed stone with the Wisconsin Stone Company.

The Home Constructing Company, Lexington, Ky., has brought complaint before the Kentucky Railway Commission against the Louisville & Nashville Railroad. The complainant asked that the rate on crushed rock from its quarries to Lexington be lowered so as to equal the rate charged to the city of Lexington from its quarry.

The Columbia Granite and Dredging Corporation, Washington, D. C., has been awarded the government contract for the construction of a rip-rap sea-wall along the Anacostia River, near Washington. The distance is about four thousand feet, and the estimated cost is $71,380.

The Tiffin Crushed Stone Company, of Dallas, Tex., has been awarded the contract to furnish the rock used in building Dallas county roads. The order may amount to 30,000 yards.

You Can Buy a Gyratory Crusher for Less than You Think



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BRONZE BALL GYRATORY CRUSHER

It has been experimented on, developed and perfected by us. It will reduce the cost of your crushed product, by reducing the amount of power consumed, by the low cost for repairs and by the increased capacity.

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Is the most easily operated, durable and simple on the market, and when fitted with a Clam Shell or Orange Peel Bucket will handle your sand, gravel, clinker, cement, concrete, coal, ore, earth or broken stone at a very low cost. You will be surprised at the variety of uses you will have for it, and the amount of money it will save you. Your complete investigation of our Cranes is invited, and we will gladly send our catalog on request.

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This Italian Pool Is Waterproofed with CERESIT

The sure as well as the economical way to permanently waterproof concrete and cement mortar is to incorporate the water repellant in the mass as is done by the Ceresit method.

Ceresit is an integral waterproofing that permeates the entire mass uniformly whether the concrete be six inches or six feet thick, or whether the cement plaster coating be ¼ inch or 2 inches thick.

Ceresit is a cream white paste put into the water used in mixing concrete or cement mortar. The water carries the Ceresit into every portion of the mixture and when set the entire mass is proof against water penetration.

It is guaranteed as an effective, permanent water repellant for all sorts of concrete construction, such as tunnels, foundations, reservoirs, dams, swimming pools, viaducts, aqueducts, bridges, sewers, water tanks, water towers, cellars, walls, floors, boiler pits and roofs. Ceresit waterproofing is equally efficient as a dampproof and waterproof for cement mortar on concrete, brick, tile or stone; also on cement, stucco and interior finishes for residences.

"Ceresit" Waterproofing

Please write for Free Book "Q" and try Ceresit waterproofing on your next job. Ceresit is used in all civilized countries. Ceresit is catalogued in Sweet's Index.

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Main Office: Clark and Adams Streets, Chicago
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JEFFREY MFG. CO.

The Jeffrey Mfg. Co., of Columbus, Ohio, has just issued a new complete catalogue of about 600 pages, illustrating fully the extensive line of conveying and elevating machinery, power transmission, crushers, pulverizers and sundry appliances manufactured by them. This catalogue is a worthy continuation of the many handy books published by the company heretofore. The Jeffrey Mfg. Co. is placing this catalogue in the hands of its customers and intending purchasers.

SAND AND GRAVEL WASHER.

As every worker in concrete knows, or should know, nothing is so important as clean sand and gravel, and these are often hard to get. There is a machine for washing sand and gravel that has solved completely this problem for every concrete man. It is made by the Stocker Concrete Material Washer Company, Higland, Ill.

The Stocker Gravel and Artificial Stone Company has been operating for years, and, feeling the necessity of a device to clean gravel and sand, Mr. F. Stocker undertook to construct one and finally succeeded in inventing the machine, thereby supplying a want generally felt in the concrete industry.

This machine has been tried thoroughly and found to be practical and advantageous in every respect. Its construction is very simple and strong, most durable and comparatively cheap. It can be readily operated by anyone, since there are no complicated parts to get out of order.

The machine can be easily transported from place to place if desired. This feature is particularly advantageous in case of bridge building, pier and abutment work; in such case the machine can be moved to creek or river bank, where sand and gravel can be found in abundance nearby, however usually too much mixed with mud, dirt or other impurities to permit their use; but if washed right on the spot the cost of hauling the material from a distance, sometimes for miles, is saved.

The washer is all metal, the end frames are cast iron, the revolving drum is of No. 16 sheet steel. On the inside of the drum are riveted angle iron bars, to which steel strips are riveted, forming an elevator carrying the material to the upper part of the drum, whence it drops into steel chutes, which are stationary and at a fixed angle, conveying the material forward; from the chute it falls into water at bottom of the drum, taken up by the elevator and dropped into the next chute and so on until the washed material finally is discharged from the last chute.

The machine can be operated with a 2-horsepower gasoline engine, is well made, strong and durable.

The capacity of the machine is about 75 tons per day of 10 hours, washing sand and gravel containing 20 per cent of clay (result of actual tests) and will require only from 10 to 15 gallons of water per minute. Then, too, the price is within the reach of all. Write them to-day for prices, catalogues and mention Cement & Engineering News.

REINFORCED CONCRETE BUILDINGS.

A treatise on the history, patents, designs and erection of the principal parts entering into a modern reinforced concrete building. An excellent and elaborate publication on the subject by E. L. Ransome and A. Saurbrey. Price, $2.50. Sent upon receipt of money order by Cement & Engineering News, Schiller Bldg., Chicago.

MEDUSA WATERFROOFING.

Under the title given above, the Sandusky Portland Cement Co., publishes a booklet describing in detail the splendid results obtained with their waterproofing compound which has been on the market for the past ten years and is too well known to require further comment.

UNIVERSAL PORTLAND CEMENT.

Universal Portland cement was sold last month to the Wayne county (Michigan) road commissioners for forty miles of all-concrete pavement to be constructed this spring. This will take about 100,000 barrels in all and is the largest order for cement for concrete road construction on record.

It is an interesting fact that autoists riding through Wayne county have splendid roads throughout except where some of the small town streets are encountered. These are becoming better, but are not comparable with the county roads, 33 miles of which are of the all-concrete type.

SAND AND GRAVEL BEING TAKEN FROM RIVER BED BY USE OF MACHINERY.

A drag line dredge has been installed for the Contractors' Supply Company, Marion, Ind., of which A. C. Wright is manager, at the river and about on a line with the extension of East Ninth street. The purpose of the machinery installed is to raise the sand and gravel from the river bed to the left bank of the river and deposit in a place accessible for both the wholesale and retail trade.

The machinery has just been installed and from the right bank of the river where there is an extensive deposit of splendid sand and gravel the big scoop or shovel at one dip will load itself with one yard of the material and by the use of steam propelling power carries this load over a huge cable to the opposite bank and dumps it high and dry sixty feet above the river and about 450 feet distant from the sand and gravel bed.

While only a trial has been given this drag line dredge it is regarded that from 200 to 400 yards of gravel daily may be taken from the river and deposited on the bank where it is easily accessible for loading wagons or cars. The sand and gravel will be delivered by the Contractor's Supply Company to any part of the city.

KANSAS CITY CRUSHED STONE PLANT.

The Kansas City Rock & Sand Company, Kansas City, is enjoying a fine business, and is supplying large quantities of special size of crushed rock in the Kansas City market. The new plant, which was completed last fall, is located in the east end of the city, on the Kansas City Southern railroad. The offices of the company are in the Victor building. A. P. Nichols is president; J. T. McGraw, vice-president, and W. B. Taylor, secretary and treasurer.

REINFORCED CONCRETE DESIGN.

Reinforced Concrete Design is the subject of a new book by O. Faber and P. G. Bowie just received from the printer. Price, $3.50. Sent postpaid by Cement and Engineering News upon receipt of money order.

CEMENT
... AND ...
ENGINEERING NEWS

A NOVELTY IN CONCRETE RESIDENCE CONSTRUCTION.

Residence construction has developed, to a certain extent, along lines dictated by available materials. Architects have aimed at unity between material and purpose as being necessary to the expression of harmony and utility. With the introduction of concrete came new possibilities in flat-arch construction, in clean lines and in freedom from small decoration. This required a new treatment of the home problem, a design differing in many essentials from practice, in order to do justice to concrete. It is refreshing to see an example of residence construction in which those unusual features of construction which distinguish concrete from all other materials are made maximum use of as features of decoration.

At Mt. Lebanon, Pa., is a house which varies from all precedent and which is of a true concrete type. It stands on a knoll overlooking a beautiful valley. The house is of monolithic reinforced concrete, not only for the foundations, walls, beams, partitions and floor slabs, but also for many details such as mantels, laundry accessories, shower receptor, baseboard and trim, flower boxes and water tanks. Surmounting the walls is a parapet, the upper rail of which is trough shaped for holding plants and vines. The owner calls it a "Florapet." The roof is of concrete, reinforced against expansion, and has a slope of ¼ inch to the foot, draining through two central leaders to the basement. The fall from the roof level is utilized to force the water to a covered concrete cistern on a near-by hill, a few inches below the level of the roof from which it runs by gravity to the house.

The exterior walls are finished in two colors, the body being gray and the trim white, the aggregate being white sand with white cement. Concrete has been used extensively inside as well, though the floors are of oak, laid on 2 x 4 inch sleepers. There is no main stairway in the house, instead a ramp or incline has been built. There has been included a system of indirect illumination, and many other interesting features which have served to make this house not only architecturally good, but serviceable, durable, and thoroughly fireproof in construction. The owner, Mr. Andrew G. Smith, a lawyer of Pittsburgh, was assisted in the design by Mr. A. Morgan Smith, his brother, an architect and concrete specialist of Mt. Lebanon, Pa.

CEMENT AND ENGINEERING NEWS

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WILLIAM SEAFERT, Editor and Publisher

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CHICAGO, AUGUST, 1912

GOOD ROADS.

All the efforts that have been made in the last decade to give the United States a system of public roads equal to the one possessed by France will come to a focus in Atlantic City from September 30 to October 5, when the American Road Congress holds its first annual session. The date and place for holding the Congress have just been announced by Logan Waller Page, Director of the United States Office of Public Roads and active president of the Congress.

The American Road Congress will mark the consolidation of the conventions of forty of the most important road organizations in the United States, including the American Association for Highway Improvement and the American Automobile Association. Atlantic City has tendered the use of the Million Dollar Pier for the great gathering, and it is there that the daily sessions will be held. President Taft is the honorary president of the Congress, which has for its active president Director Page, and for its treasurer Lee McClung, Treasurer of the United States.

The National Association of Road Machinery and Material Manufacturers has voted to hold its exposition of materials and equipment in conjunction with the Congress. Among the members of the Manufacturers' Association are many of the largest manufacturing companies in the world. Every industry relating to the building and care of roads and bridges will be represented, and it will be possible for the road builders and road users to acquaint themselves fully with all the labor saving devices, methods and formulas that American ingenuity and inventive genius have brought out during the past century.

A remarkable ingenious exhibit will be made by the U. S. Office of Public Roads, consisting of a complete set of miniature models illustrating every known type of roads and miniature working models of rollers, crushers and various equipment operated by tiny electric motors. The government's priceless collection of models showing the development of transportation from the primitive human burden bearer to the modern automobile and locomotive may also form a feature of the exposition. "Old Trails" exhibits, recalling scenes along the famous old roads and trails such as "The Old Cumberland Road" and the "Santa Fe Trails," will add picturesqueness to the display.

One of the principal organizations composing the Congress will be the American Association for Highway Improvement, composed of about 1,500 men who are leaders in their respective lines of activity throughout the United States. Interstate Commerce Commissioner James S. Harlan is Chairman of the Board of Directors; W. W. Finley, President of the Southern Railway Company, is Chairman of the Executive Committee; Thomas Nelson Page, the noted author, is Chairman of the Membership Committee; and W. C. Brown, President of the New York Central Lines, is Vice-President of the Association. Thirty-five organizations for road improvement are identified with the Association and twenty railroad companies are giving it their support.

The American Automobile Association will represent at the Congress the large and ever-increasing number of road users, who, while adding to the difficult problem of road construction and maintenance because of motor traffic, are giving a new importance and uses to the roads and are contributing heavily to road improvement. Tours from all important cities will be conducted by the Association in time, so that all will arrive in Atlantic City on Road Users' Day. From Quebec and intermediate points will come a great contingent of goods roads enthusiasts who are striving for a great through international highway stretching from Quebec to Miami, Florida, traversing the entire American seaboard. These will be met at Atlantic City by the southern boosters, who will come from Miami and intermediate points. The arrangements for these tours will be under the direction of the American Automobile Association and the American Association for Highway Improvement.

The United States is paying $1,000,000 a day for our roads, more than $300,000 of which, according to government estimates, is wasted. Some of this country's roads are among the finest in the world; many of them are the worst in the world. It is to find ways and means of stopping this tremendous drain of road revenues, and of introducing the best possible methods of management of construction and of maintenance that the leading engineers, chemists, financiers, legislators, educators, and executives will assemble at Atlantic City. The first two days of the Congress will be assigned to the road users under the auspices of the American Automobile Association, the second two days to the great problems of legislation, finance and economics under the auspices of the American Association for Highway Improvement, while the last two days will be given up to the engineers, who will discuss problems of construction and maintenance, and to the various associations, which will meet and map out their plans of action, correlate their efforts, and make definite arrangements to pull together in the greatest campaign for road improvement and wise, conservative management ever undertaken.

WESTCOTT & RONNEBERG.

Westcott & Ronneberg, consulting engineers, have moved into larger and more commodious quarters in the new Otis building at the corner of Madison and LaSalle streets, Chicago. This well-known firm of engineers make a specialty of designing reinforced concrete buildings and bridges and invite their many friends to inspect their new quarters.

The Action of Alkali on Cement Pipe Lines

By Will L. Brown

It might be of interest to some of our water companies and individuals and also to some of our contractors in this land of irrigation, to know some of the effects of alkaline water on cement pipe. A knowledge of when not to use any material is far more just to that material than to condemn it entirely because it has failed in some instance when it should never have been used at all.

My attention was called some time since to a cement pipe line in the upper San Bernardino Valley adjoining this city that had become "rotten" and failed. In company with two other engineers, I made an examination of the line in question and was much surprised at what we found.

The pipe was about 1000 feet long, ten inches inside diameter, and made and laid under contract as a drain from a pump pit situated in a low, wet tract of land. The ground water in this tract was from three feet to five feet below the surface in summer, and in winter, water stands in all depressions. The soil itself is a close-grained, fine sand, and clay, quite heavily charged with those mineral salts commonly termed "alkali."

The "alkali" from this particular locality has never been analyzed as far as I have been able to learn, but is probably of the same composition as other white alkalies of Southern California, viz., the sulphates of calcium and magnesium, together with smaller quantities of sodium chloride, nitrate, carbonate and generally some bicarbonate. Altogether this makes a very caustic, active solution, especially that portion at or near the surface, where for many seasons the waters working up from below have brought the salts with them, and then evaporating during the succeeding dry summers have left excessive quantities of the solids, as a white incrustation or efflorescence.

The pipe was a good average cement pipe, made under a 1 to 4 specification, and although no especial pains were taken, either in mixing the aggregate or in the tamping and curing, it would pass inspection without any serious objection. It was washed inside with a neat cement wash to lessen its porosity. The line was laid from four to eight feet deep, with considerable difficulty, because of water and caving trench. Some of the joints were made with plaster paris, but the jointing was seldom water-tight.

The third year after laying, depressions appeared over the line and during the fourth year several large pits formed—some of them eight feet across and of various lengths. In several instances when the surface dropped, tunnels were observed, extending along the line. This sinking was caused by ground water washing the earth away wherever a pipe failed. In the fifth year the line was entirely useless, and a new line of vitrified clay pipe was constructed.

An examination of many fragments of pipe taken from the line showed the cement to have almost entirely disappeared from the outer portions of the pipe wall. The sand could be readily crumbled with the fingers, it often being nothing more than a sandy mud. What cement-like material still remained had no life or strength at all.

The inner part of the pipe wall where the cement wash had penetrated about three-eights of an inch was less affected and retained its form, though possessing little strength. These fragments when allowed to dry in air crumbled and often fell apart.

This disintegration of cement in the presence of alkaline solutions has been very carefully investigated by the chemical department of the Montana Agricultural Experiment Station and also by the Colorado Agricultural College. The results of these independent investigations show a remarkably close agreement, and with a number of similar failures that have come under the writer's observation, indicate that the use of cement pipe in many locations is very likely to be a misuse of this very economical material.

The chemical reactions taking place when the alkaline ground waters come in contact with the cement, are very complex. The liberation of calcium hydroxide during the process of setting, and later hardening of the cement means that a compound is formed which even distilled water will dissolve and carry away. When we have this reaction and solution taking place in the presence of strong alkaline solutions and under several pounds pressure, the effect is much accelerated. M. W. P. Headden, chemist at the Montana Experiment Station, mentions a sample of cement tiling reduced to a putty-like mass mixed with sand after being laid only eight or nine months.

These reactions are continuous; soluble compounds are formed and carried away by the percolating waters, thus constantly exposing new surfaces, and it is only a question of time when the pipe fails. This effect is readily seen in cement-lined ditches carrying a constant stream and even in irrigation pipe with only an intermittent flow.

All the ground waters of the Southwestern United States carry a considerable content of these alkali compounds, especially magnesium and calcium sulphates. All sulphates are very active in their action on cement and magnesium sulphate is the most active of all. The water coming from our granite mountains contains this salt in very large proportion. Its action on cement can be clearly observed in every cement lined conduit, even the stones laid in cement mortar and lining many ditches, can often be lifted out or will drop, after two or three years of contact with the running stream.

Most interesting and complete discussions of this subject are given in Bulletin No. 132 of the Colorado Agricultural College, and in Bulletins 69 and 81 of the Montana Agricultural Experiment Station.

Quoting from Circular No. 8, issued by the Montana Experiment Station: "We recognize this as a cement age, but this fact does not warrant its use in important structures by people who have not given it some special study. With our present knowledge we could not advise the use of cement pipes for drains or sewers where they are to be laid in alkaline ground. When prepared by the boundary methods we believe that concrete should not be used where solutions of alkali will come in contact with it. In such pipes or drains the pressure of the ground water tends to force the alkali through the concrete and hasten the disintegrating action."

Here in Southern California where hundreds of thousands of dollars in crop values depend on irrigation, the users of this kind of pipe should investigate this matter for each location or system, as the failure of a pipe line during a critical period in our dry summer might mean the loss of many times the cost of a more durable material.

GIANT GRIFFIN MILL.

The Bradley Pulverizer Company has made arrangements for the manufacture of the Giant Griffin Mill and parts at the Allentown (Pa.) works and are continuing the manufacture of the Bradley Three Roll mill for fertilizer use in grinding phosphate rock and Florida pebble at the Boston Works. This has been necessary on account of the demand for the Bradley Three Roll mill for use in the fertilizer business. An officer of the company says: "On account of the successful operation of the Giant Griffin Mill and its predecessor the 30" (Original) Griffin mill, it has been understood by some that we only manufacture pulverizers for the cement trade. This is now only part of our large business, as the Bradley Three Roll Mill is being used in a majority of the fertilizer plants on account of its simplicity of operation and economy in up-keep with only thirty-five horsepower.

"Not only are the phosphate rock grinding people beginning to realize the value of the Bradley Three Roll mill but also the fire clay manufacturers are installing them for grinding tailings. One recent installation of a Bradley Three Roll Mill at the plant of the Olive Hill Fire Brick Company, Olive Hill, Ky., is giving an output of from 10 to 15 tons per hour at a very low cost of up-keep.

"Another use for the Bradley Three Roll is the grinding of limestone for agricultural lime purposes. This commodity is being used universally and is becoming very popular with the farmer. We have just installed one of these mills at Medina, N. Y., for this purpose, and we are in receipt of some very flattering reports on the outcome of tests made at that plant.

"Probably the reason for the great popularity of both the Giant Griffin and the Bradley Three Roll is on account of their being self-contained machines, requiring no auxiliary screens for procuring necessary fineness. This is a great point in favor of all our different mills and is required by the trade we serve. Auxiliary screens and the additional elevators they require are a source of trouble and expensive in up-keep and horsepower.

"Another point in our favor is the fineness of the grind. It is a known fact that the Giant Griffin Mill is the finest grinder on cement clinker that has ever been used. Also the Bradley Three Roll Mill will give a greater percentage of 200 mesh material. This is quite essential in both the grinding of phosphate rock for fertilizer purposes and the grinding of limestone for agricultural lime. The average mills used for this purpose are not suited to the use of the ordinary operator, being too complicated and require the attention of skilled mechanics. Any operator with ordinary judgment can operate the Bradley Three Roll mill very satisfactorily.

"It is now about twenty-five years since we started to build Griffin Mills and there are more of these mills in successful use than all other mills combined. We have kept abreast of the times carrying on extensive experiments and tests, continually trying if possible to improve our various mills. In this we have been quite successful, as the great number of installations of both the Giant Griffin and Bradley Three Roll Mills will show. As it has been necessary we have made improvements on both of the above mentioned mills and are satisfied that for fineness of grind, low cost of up-keep and economy in horsepower there is no other mill that can compare with them.

"The grinding of phosphate rock in connection with the fertilizer business being a much newer proposition than that of grinding cement materials, the number of installations are not as great, but the success which all our users are having assures us of a larger business in the future that will equal our great success in the cement business.

"We have some exceptionally good data on up-keep, horsepower consumed and fineness of grind, which we will be very glad to furnish to interested parties."

SEES CEMENT RISE.

A cement famine calculated to redound greatly to the benefit of the cement mills in St. Louis and the East was reported yesterday by A. H. Craney, Jr., first vice-president of the Union Sand & Material Company, which owns one of the two cement mills in the St. Louis district, the St. Louis Portland Cement Company's mill at Prospect Hill Station on the Burlington. The other mill is the Continental, a few miles south of St. Louis.

The cause of the famine, according to Craney, is a scarcity in three Canadian provinces, Manitoba, Saskatchewan and Alberta, and a crippling of the ten cement mills in southern Kansas through the diminution in the pressure of natural gas which these mills use as fuel in their kilns. St. Louisans are largely interested in these oil fields and in the industries connected with them.

The St. Louis Portland Cement Company was notified yesterday by the Canadian Pacific Railway, through W. M. Porteus, its St. Louis agent, that the Canadian government would grant a remission of 50 per cent in the duty on cement and hydraulic or water lime in barrels, bags or cases, imported from the United States, between July 12 and October 31, inclusive.

Craney yesterday declared he expected cement prices to show a very considerable rise at once. He sent a dispatch Thursday to several eastern cement producers, including the Atlas, the Lehigh and the Universal, reading as follows:

"Reports reach me of a most positive and alarming diminution of pressure in the natural gas fields supplying the Gas Belt cement mills. This circumstance, coupled with the known cement famine in Canada, which has led today to a reduction in the Canadian duty on Portland cement from the states of 50 per cent certainly should be reflected promptly by higher prices in all territory immediately affected."

"The pressure in the gas pipes supplying the Kansas mills has gone down from 400 pounds per square inch in January to 130 pounds in April," said Craney yesterday. "I understand that one of the largest mills was down for days last week, being completely out of gas, and that it is now running only two kilns. Like conditions must prevail in all the mills in the gas belt with the exception of the Dewey mill, which receives its gas from another supply. In times past when the gas failed these mills used oil, but this is impossible now, because of the shortage of oil in the district, and also because the price of oil has advanced 50 per cent in the last ninety days, and there is no oil available for burning in the district. The only way for the Kansas mills to get gas is to install a compressor station in the Hog Shooter district. This will cost about $250,000, and the installation could not be made available for this season's business. The only other possibility is coal, and I know the mills in the district are asking high prices on coal-grinding machinery. Besides, it would be impossible to install coal-grinding machinery in time to use it for this year's business."

An Improved Concrete Pavement

By E. W. Groves.

Some years ago the writer became convinced that the forms of street pavement commonly used were too expensive to come into general use, especially on residence streets, in both our large and small cities and on country highways. If the demands of modern traffic were to be satisfied, a much cheaper form of pavement must be devised, yet one having all the essential characteristics of permanency and low cost of maintenance. With this idea in view, concrete pavements constructed in the ordinary manner, were inspected and it was found that while the concrete had the strength to support the weight imposed upon it, it was readily susceptible to the abrasive action of traffic as well as to changes in volume, which produced cracks, which in turn, under the action of wheels and hoofs, soon became enlarged into ruts. Previous to this inspection the writer had caused a section of a street paved with asphalt blocks, which was rapidly disintegrating, to be covered with a thin coating of crude coal tar and sand. The effect was wonderful. The new coating took all of the wear which had formerly been on the asphalt blocks and preserved the pavement, which is in good condition today. The pavement is less noisy than before, and not as slippery as sheet asphalt.

For some time the citizens living on a certain block in this city had desired that it be paved. But they were unwilling to pay such high prices as had been charged for pavement. In an effort to satisfy their request the writer conceived the idea of laying a concrete pavement and covering it with a coating of tar and sand. Accordingly, with the consent of the city authorities and the property owners, we paved one block, of ,1883 square yards with concrete, covering the surface with hot crude coal tar and sand, using about one-half gallon of tar to each square yard of pavement. After this pavement had passed through the winter of 1909 and 1910 and our citizens had an opportunity to judge its merits, petitions were presented asking for over 20,000 sq. yds., which were laid during the summer of 1910. During the winter and spring of 1910 and 1911 petitions were presented asking for about 70,000 sq. yards, of which 64,000 sq. yds. were laid and at the present time we have on file petitions asking for 140,000 sq. yds. more, which will be laid as soon as conditions are favorable.

Let us return to the subject of the change of volume of concrete. The writer, of course, was aware that such a change occurred. He had his ideas, as all of you have. But it remained for Prof. A. H. White, of the University of Michigan, to tell us the reason for the greatest volume-change. In a paper read before the American Society for Testing Materials and published in their Proceedings, Vol. XI, 1911, Prof. White gave the results of certain experiments performed by him. In his introduction he speaks of the "Constancy of volume" of cement mortars and calls it a "misnomer." Any one can see from cracked walls, sidewalks and other concrete structures, whose failure is not due to the settling of foundations, that there is some inherent characteristic which causes cement, cement mortars, and concrete to change volume if exposed to the weather.

He says: "The change of volume of concrete due to changes in temperature has been determined with considerable accuracy to be per unit length 0.0000055 or 0.00055 per cent. per degree Fah. There are, however, other changes due to the chemical process of setting and hardening which are barely mentioned in even the more important treatises and other variations due to the wetting and drying of the concrete, whose very existence is practically unknown."

He deals with these latter and previously unknown changes. From earlier experiments by Schuman, Gary, Considere, and Campbell and White it was definitely determined that neat cements, hardening under water, expand at a decreasing rate for years, and that neat cements, hardening in air, contract similarly, and that cement-sand mortars act in the same manner as neat cement, but to a less degree.

Mr. White has been experimenting for twelve years or so with neat cements and various sand mortars. He has found that neat cement, when immersed in water for a period of three years, showed a linear expansion of from 0.10 to 0.15 per cent., nearly all of which occurred during the first year. When these bars were allowed to dry in the room (temperature about 70 degrees Fah.) for sixty-five days they had contracted to their original volume and in some cases 0.05 per cent. less. Upon re-immersion in water they regained all their previous expansion in about one day, and some expanded more than they had ever done before. In one specimen of natural rock cement the expansion in water during the same period of time and under the same conditions went as high as 0.55 per cent, but on drying contracted +0.25 per cent. He also tested in the same manner various bars composed of a 1:3 mix of sand mortar and compound bars of neat cement and 1:3 mix. The first bars behaved like the neat cement, only in a less marked degree. In the compound bars the neat cement part acted in the same manner and in the same degree as the other neat cement bars, while in the 1:3 mix there was a tendency to lag in both expansion and contraction. This difference of expansion, of course, set up sheering stresses at or near the line of demarcation. In some cases these sheering stresses were great enough to rupture the bars.

To take some examples of this from actual practice, the writer can site numerous cases in Ann Arbor where the sidewalks have broken apart, that is, the top course broken loose from the bottom course, and in every instance it could be seen that the line of fracture did not conform to the line of demarcation, but was below in the leaner mix. There was a film of the base concrete from 1/64 to ⅛ and in some cases ½ of an inch in thickness clinging to the top course, showing that the failure was not due to poor bonding between the two courses. Doubtless every one of you have seen a sidewalk buckle up in an inverted V. This occurred in some of the walks on the campus of the University of Michigan, and on several of the city streets in walks that have been laid from one to ten years. The peculiar thing about the failure was that it occurred during the summer months, thus precluding any result of the frost action. There remains only the moisture to blame, since the expansion due to heat is so small. To the writer's mind the foregoing proves conclusively that the great destruction of concrete pavements is due, first and foremost, to the alternate wetting and drying when they are unprotected.

Now, this coating of bitumen and sand is waterproof. Thus the greatest cause of the destruction of concrete pavement is eliminated. The writer does not care to go into the question of water from below or

sub-drainage. The greater portion of the streets of the city of Ann Arbor are of a gravelly soil and thus drain themselves. However, a portion of one street is clay and the pavement was laid directly upon it, and shows no ill effect up to the present time, and none is expected.

The pavements laid during the seasons of 1909 and 1910 were treated with crude coal tar, and while this material was fairly satisfactory, it was evident that a distilled product having a uniform consistency would be better. Experiments were made with various products of the distilled tar, tarvia, and asphalts with various degrees of viscocity. These were all more or less unsatisfactory, more especially the products containing asphalt oils. As objectionable features made their appearance efforts were made to overcome them. Extensive laboratory tests produced a bitumen which has none of the objectionable features of the crude tar, tarvia and asphalt. This bitumen, when applied to the concrete at a temperature of 180 degrees Fah., is thin enough to bond into the interstices of the base, making an impervious surface.

The pavements laid up to the present time have been made up of two layers of concrete, viz.: a base 4½ inches thick composed of one part of cement to eight parts of bank run gravel, and top layer 1½ inches thick composed of one part of cement to two parts of gravel passed through a screen having a one inch mesh, the top course being applied immediately after the bottom course is laid to insure a good bond. Since the top coat of a pavement laid in this manner contains more cement than the bottom, and since it has been shown that such a construction tends to produce internal sheering stresses; there is a possibility of separation of the two layers. While no action of this nature is apparent in our pavements, due to the waterproofing effect of the bitumen, to be on the safe side, all our future work will be one coat work, using approximately one part of cement to 4½ parts of bank run gravel.

It has been the practice to leave an expansion joint about ¾ of an inch wide at each curb, and also every 25 ft. transversely of the street. After the surface of the concrete has been troweled to conform to the crown of the street, and when it is partially set, a light wire broom is used to roughen it in order to furnish a better surface for the adhesion of the bitumen. Later the expansion joints are filled to a little less than one inch of the surface, with sand upon which is poured hot bitumen, making the joint filling flush with the surface of the concrete. After the concrete has become thoroughly set and is dry and clean (being swept if necessary) one half gallon of bitumen heated to a temperature of 180 degrees Fah. is spread over each sq. yd. of the surface of the pavement, and while this bitumen is still hot and soft it is covered with a layer of torpedo sand ranging from ⅛ to ¼ inch, using about one cubic yard to each 250 sq. yds. of pavement. The street is then immediately opened to traffic which grinds the sand into the bitumen and produces a rubbery surface, black in color, almost noiseless, and having the apparance of sheet asphalt.

As to the cost of maintenance, I can only speak from an experience of three years. With upwards of 80,000 sq. yds. of this pavement, constructed during the last three years, not to exceed $30.00 has been expended on repairs, and the pavement is in good condition to-day. The owner of a frame house, in building, does not consider that the first painting will last the life of the house. He plans for the expense of repainting every few years. Its initial cost is low enough to allow for maintenance charges. It must be kept in mind that there is no pavement that is entirely free from maintenance charges. In summing up the advantages of this pavement, it may be said that the concrete, if properly and honestly constructed, is strong enough to sustain the weight of the traffic which passes over it. The bitumen prevents the absorption of water by the concrete and thus preserves it from cracking. The change of volume due to temperature is negligible. The combination of torpedo sand and bitumen gives a wearing surface which is unexcelled. The construction cost is low as compared with other pavements and requires no cumbersome and extensive plant. When it becomes necessary to put pipes of any sort beneath the pavement repairs are easily and perfectly made, no ridges or hollows being produced. With a firm sub-base no reinforcement whatever is necessary for the stability of the pavement. With the manner of filling the expansion joints described above, there is no shipping or crushing of the concrete at the edges. If the filling is carefully done it is impossible to point out an expansion joint in the finished street. When the hot sun of summer heats the pavement there is absolutely no free bitumen coming through and sticking to the feet. It does not "bleed." Our citizens are so well satisfied with it that they will not consider any other form of pavement. It is, indeed, a most suitable pavement for country highways, parks and boulevards, as well as city streets. With gravel banks, ledges of rock, marl clay and sand, the essential elements of concrete so profusely distributed throughout this country, the bitumen easily obtained, a pavement that can be laid for about one dollar a square yard based on Ann Arbor prices, and that is durable, noiseless, and pleasing to the eye, I can see no reason why it should not become the most universally used of any or all of the various pavements before the people to-day.

PRODUCTION OF PORTLAND CEMENT IN 1911.

The total production of Portland cement in the United States in 1911, as reported to the United States Geological Survey, was 78,528,637 barrels valued at $66,248,817. It is interesting to note that this quantity reduced to tons is equivalent to 13,321,822 long tons, valued at $4.97 per ton. As compared with the pig-iron output for 1911, which was 23,257,288 long tons, having a value of $327,334,624, or $14.07 per ton, the Portland cement production approximates 57.28 per cent of the quantity of pig iron, and 20.24 per cent of its value. As compared with the production of Portland cement for 1910, which was 76,549,951 barrels, valued at $68,205,800, the output for 1911 represents an increase in quantity of 1,978,686 barrels, or 2.58 per cent, and a decrease in value of $1,956,983, or 2.87 per cent. The average price per barrel in 1911, according to the figures reported to the Survey, was a trifle less than 84.4 cents, as compared with 89.1 cents in 1910. This represents the value of the cement in bulk at the mills, including the labor, cost of packing, but not the value of the sacks or barrels. This average price per barrel is about 12.9 cents higher than the average price received for Portland cement in the Lehigh district, and is a little higher than the average prices received in New York and Michigan, while it falls 34.2 cents below the average price received in the Rocky Mountain States, and 56.2 cents below that received in the Pacific coast district. In the average price for the country is included the value of 135,775 barrels of white Portland cement, which sold at an average price of about $2.50 per barrel.

CONCRETE PILES FOR FOUNDATION.

Reinforced concrete piles form an important part in the construction of foundations for the new reservoir of the H. J. Heinz Company at Pittsburgh, Pa. These piles, from 25 to 30 feet long, are made in the field and driven by means of a 12,000 pound drop hammer. The piles used for this work are of the plain, tapering type. Opposite are shown the piles ready for driving. The diameter of the head is 15 inches and the point 9 inches, requiring 25.3 cubic yards of concrete, of a total weight of 3,770 pounds.

The piles are reinforced with eight ⅝-inch longitudinal wires and a No. 5 gauge wire which passes around the pile at a 3-inch pitch throughout the entire length. It is further reinforced by four steel rings which are bound to the longitudinal wires and hold them in place. The point is protected by a shoe of No. 12 gauge sheet steel, 9 inches in diameter at the top and 1½ inches at the bottom, 12 inches long. To allow the pile to satisfactorily resist a heavy blow when being driven, the top is provided with a cushion. This cushion effect is produced by a spiral reinforcement at the top of the pile composed of five ¼ x 1-inch steel strips, 2-inch center to center, and two ⅛ x ⅜-inch steel rods 3 1-16-inch center to center. Figure No. 2 shows the steel reinforcement, the steel cushions being piled on the right in the photograph.

These piles are ready for driving in from twelve to twenty-one days after being poured. They are driven in clusters of nine piles spaced on 3-foot centers.

Steel Reinforcing and Flexible Driving Caps for Concrete Piles.

CEMENT BLOCK CRUSADE.

A crusade against cement block manufacturers in Indianapolis, Ind., who do not comply with the city ordinance regulating the manufacture and use of cement blocks has been started by T. A. Winterrowed, city building inspector. In several instances inspectors of the building department have found blocks on which the name of the manufacturer and date of manufacture had not been stamped. In one case Mr. Winterrowed condemned a large number of blocks which were about to be used and which did not comply with the ordinance. Winterrowed says not only will blocks made in violation of the ordinance be condemned, but the manufacturer will be arrested as well.

Reinforced Concrete Piles for Reservoir Foundation.

Proportioning Gravel Concrete

By Clifford Older

The bridge work of the Illinois Highway Commission involves the use of concrete under the greatest variety of conditions imaginable. The quality of concrete required varies from that necessary in massive plain concrete abutments and retaining walls to that required for light, thin reinforced floors for steel bridges.

The conditions under which concrete is built vary throughout all seasons of the year, and the location of the work may be in a city with ample transportation facilities, or it may be twenty miles from a railroad with dirt roads and 10 per cent. grades intervening.

The quality of available aggregates may be the best of crushed limestone and coarse river sand, or it may be gravel of infinitely varied character. The quantity needed for the work may also be anything from a few cubic yards to several hundred or even thousand cubic yards.

Handling the construction of a large number of concrete structures under greatly varying conditions made it necessary to devise a set of specifications for concrete work which would provide for concrete of satisfactory quality under all conditions and yet be elastic enough to permit the use of a considerable variety of aggregate.

When the bridge is located comparatively near a railroad station, it is frequently possible to secure broken stone and sand at a reasonable cost. Many county highway bridges, however, are located perhaps five, ten or fifteen miles from a railroad, in which case, if broken stone and sand were required, the cost of concrete structures would be beyond the reach of many communities.

Gravel.—The admission of gravel for aggregate permits the economical use of concrete in practically all Illinois townships, however remote from stone supply. Gravel as nature provides it has, however, an infinitely varied mixture of sand, pebbles and stone. Gravel as known to local highway officials and to most contractors may, in some cases, contain stone from three inches in diameter down, and in others it may be a material all of which will pass through a ⅜-inch or even a ¼-inch screen. It is all popularly known as gravel, and the standard mixture is 1 part cement to 6 or 7 parts of gravel.

The abuse of gravel concrete in small country highway work is astonishing. One local contractor, who was building a small bridge, insisted that a proportion of one of cement to six of gravel meant one sack of cement to six wheelbarrows of gravel.

The specification adopted provides for the use of broken stone and sand when available by stating the number of parts by volume of each ingredient. Screened gravel is treated in the same way. Unscreened gravel is also permitted under certain conditions.

The clay or loam content is limited by the specifications to 2 per cent. of the sand. But few natural gravels will satisfy this requirement. Larger percentages are frequently allowed if the gravel is otherwise of good quality.

To secure the necessary strength, the cement is proportioned according to the amount of sand contained in the gravel, sand being defined as that part of the gravel which will pass through a ¼-inch screen. The only requirement as to the relative proportions of sand and stone in the gravel is that the volume of sand must not fall below six-tenths of the volume of stone. Any gravel, therefore, having a sand-to-stone ratio greater than 0.6 may be used without modification, but for gravel so used the cement-to-sand ratio must be constant for a given class of concrete.

This provision permits the use of practically all gravels composed of satisfactory material. The resulting proportions stated in the usual form may vary, for a certain class of concrete, from 1 part cement to 2¼ parts sand and 4 parts of stone to a mortar mixture of 1 part of cement to 2½ parts sand.

This method of proportioning is based on the assumption that if the sand and the stone are of satisfactory quality, and the ratio of sand to stone is equal to, or greater than 0.60, the strength of the concrete will be satisfactory, providing the ratio of cement to sand, or, in other words, the mortar is always maintained constant for a given class of concrete.

Specifications for broken stone and gravel concrete require for class X concrete 1 part cement, 2 parts sand and 3½ parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1-inch ring; for class A concrete 1 part cement, 2½ parts sand and 4 parts rock broken to pieces which will be retained on a ⅜-inch screen and which will pass a 1-inch ring, and for class B concrete 1 part cement, 3 parts sand and 5 parts rock broken to pieces which will be retained on a ¾-inch screen and which will pass a 2½-inch ring.

Gravel may be used in the place of broken stone and sand for concrete if it consists of clean, hard and sound stones, pebbles and sand, having a reasonably uniform gradation from the coarsest material allowable for the work specified to fine sand

In proportioning gravel concrete, frequent tests are made to determine the proportion of sand to stone. For class X and class A gravel concrete all material which passes a ¼-inch screen and passes a 1-inch screen is considered stone. For class B gravel concrete all material which passed a ¼-inch screen is considered sand and all material which is retained on a ¼-inch screen and passes a 2½-inch screen is considered stone. For any of the classes of concrete, should the volume of sand so found be less than 60 per cent. of the volume of stone, sufficient sand must be added to bring up the proportion. Should the volume of sand be more than 60 per cent. of the volume of stone, stone must be added or sufficient cement so that the volume of cement to sand shall be for class X concrete as 1 to 2; for class A concrete as 1 to 2½; and for class B concrete as 1 to 3.

Pit-run gravel is defined as a mixture of sand and stone.

Sand is that part of pit-run gravel which will pass through a ¼-inch screen.

Stone is that part of pit-run gravel which will be retained on a ¼-inch screen which will pass through a screen of the size indicated for the given class of concrete.

Sometimes it is convenient to proportion gravel concrete by relative volumes of cement and total aggregate. To determine this relation, first compute the number of sacks of cement per cubic yard of the aggregate as it is to be used in the mixture; then the volume in cubic feet of cement per cubic yard of aggregate equals 0.95 of the number of sacks and the proportion of cement to aggregate equals 27 divided by this quantity.

It is often cheaper to resort to screenings in order

to obtain the stone necessary to modify the gravel to the 0.60 ratio than it is to add cement or purchase broken stone.

With cement at $1 per barrel on the ground and 30 cents as the cost of screening 1 yard of gravel, assuming that the gravel is free at the pit or that it is necessary to purchase only the amount of gravel hauled away, it will be seen that screening is cheaper than adding cement up to where proportion of same is 0.90. With the cement on the ground at $1.50 per barrel and screening at 30 cents per yard; gravel being free at the pit or the material hauled away only being paid for, there is a very marked saving in cost by screening up to a proportion of sand of 0.93 over the method of adding cement.

With cement at $1.50 per barrel, screening at 30 cents and gravel at 40 cents, all gravel screened as well as that hauled being paid for at this rate, it is still cheaper to screen the gravel in order to find stone to add than it is to add cement up to values of said ratio of 0.85.

With cement at $1.50 and broken stone at $2 per yard delivered at the bridge site, the adding of broken stone is cheaper than adding cement, cheaper than screening if all gravel handled must be paid for at the rate of 40 cents per cubic yard, and is cheaper than screenings alone for values of sand ratio larger than 0.8.

A Typical Example.—An example of a case where the method of adding cement proved the cheapest for proportioning follows:

A bridge located about nine miles from the nearest railroad station required about 350 cubic yards of class A concrete. Cement was delivered at the bridge site at cost of $1.35 per barrel. At the site of the bridge occurred a deposit of gravel containing but a small amount of stone, the sand, however, being of excellent quality. The gravel was had at the cost of shoveling it into wheelbarrows. Broken stone at the nearest railroad station would have cost $1.75 per cubic yard, and the haul on account of the grades would have cost $4 per cubic yard, making the cost of broken stone at the bridge site $5.75 per cubic yard. The gravel in the creek bed tested 0.93 sand and 0.12 stone.

Using the gravel as it occurred in the creek bed required the use of 2.60 barrels of cement per cubic yard of concrete, the cost at $1.35 per barrel being $3.51 per cubic yard. Had broken stone been added, it would have been necessary to purchase about 0.7 cubic yard per cubic yard of concrete. This would have cost at the bridge site $4.02. The cement necessary would have been reduced to 1.2 barrels and would have cost $1.62 per cubic yard of concrete. The cost of cement and stone per cubic yard of concrete would have been about $5.64. The saving per cubic yard of concrete effected by adding cement at the rate of 1 of cement to 2½ of the contained sand amounted to $2.13. As there were 350 cubic yards used, the total saving amounted in this case to $745. The resulting concrete appears to be excellent.

Screening was out of the question, as to obtain the stone required would have necessitated screening nearly 1,800 cubic yards of gravel, and the visible supply was much less than this.

In general the specification for gravel concrete herein described, which has been in use by the Illinois Highway Commission for several years, has resulted in satisfactory concrete, and made concrete structures available in many places where the cost would have been prohibitive had a fixed ratio of sand to stone been required in all cases.

A MODERN LINE OF HYDRATING, ELEVATING, CONVEYING AND POWER-TRANSMISSION EQUIPMENT.

A cursory study of the business of the Weller Mfg. Co., Chicago, brings to view many interesting sidelights on the methods devised by this company to reduce handling and power-transmission costs to the minimum by effecting an economy in time and labor. The experience and reputation of this company are too well known to require comment here, and it seems hardly necessary to remark that any product of the concern can be relied upon absolutely as regards its design and general construction.

The rapid increase in the manufacture and use of hydrated lime is causing many manufacturers to install their own hydrating system. In view of this we are induced to call the attention of our readers to the lime hydrating system recently placed on the market by the Weller Mfg. Co., which promises to revolutionize the business to a very marked degree.

One of the strongest features connected with it is its adaptability, allowing the speed to be easily adjusted for different grades of lime; the advantages of this can be easily recognized.

The simplicity of operation is another great point. The Weller Lime Hydrator is stated to embody every idea known for facilitating the operation which, combined with the thoroughness of construction, insures the maximum results at the minimum maintenance costs. Notwithstanding its many good qualities, the cost of installation is remarkably low, and any manufacturer considering putting in a hydrating system would do well to take up the matter with the Weller Mfg. Co.

The business of the Weller Co. embraces the manufacture of practically every kind of equipment needed in stone quarries, etc., for handling materials and transmitting power. Weller Elevator installations are furnished complete with geared countershaft head drive, and are made in all sizes.

This company makes a very complete line of screens for use with all kinds of rock products. The Weller Conical Overhung Rotary Screen is particularly adapted to gravel washing and kindred uses, and is a greatly improved type of construction.

Various styles of steel cars are described in the company's catalog, prominent among them being their Tilting Hopper Car, Bottom Dump Car, Side Door Dump Car and an Automatic End-Dump Car. A Scale Hopper Car is also shown. They offer their large, complete catalog (No. 20) free on request.

SAND-LIME BRICK IN MASSACHUSETTS.

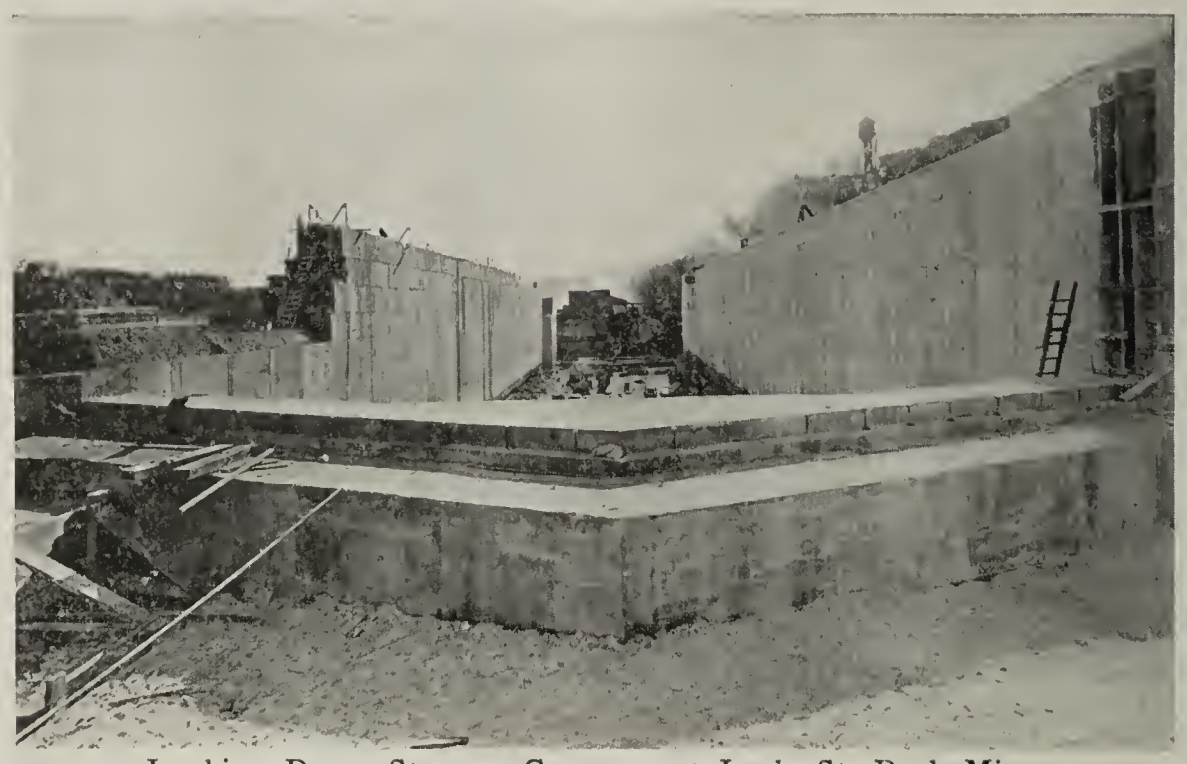
The Worcester (Mass.) Sand-Lime Co., incorporated under the laws of Massachusetts, with capital stock of $150,000, proposes to erect a plant in the western part of the town of Worcester, on the Boston & Albany Division Railroad. The officers of the company are: President, Richard C. Cleveland; vice-president and treasurer, E. Lincoln Powers; and secretary, Farnham V. Curtis. The factory will have a capacity of 40,000 brick per day, and the company will make a specialty of gray brick, although other colors will also be made.

SAND-LIME PLANT IN CUBA.

W. J. Carmichael, of the American Clay Machinery Co., by his several trips to Mexico, has acquired a familiarity with the Spanish language, which especially fits him for the work he is now carrying on, i. e., the establishing of a big sand-lime brick plant in Cuba.

Concrete Lock and Dam at St. Paul, Minn.

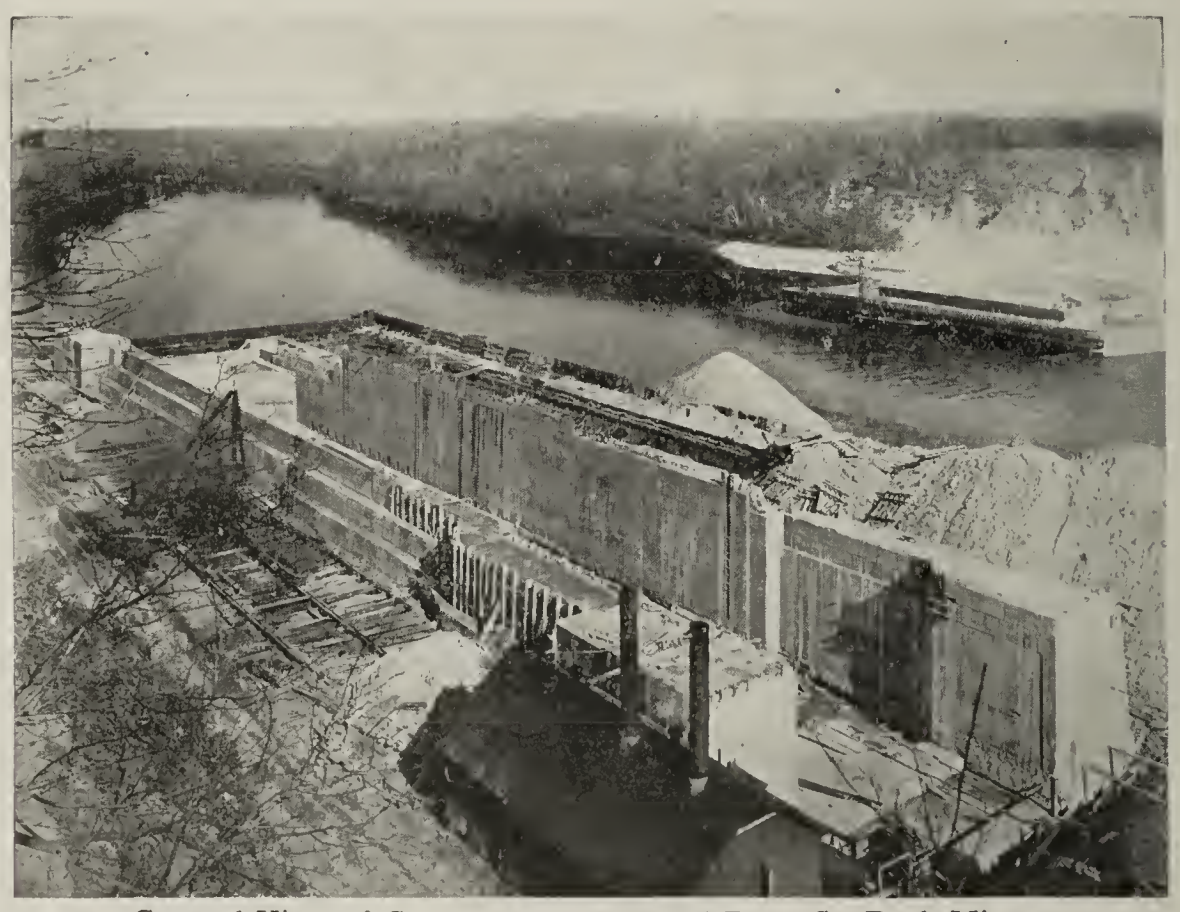
The original project for the Mississippi River improvement between St. Paul and Minneapolis provided for two locks and two dams, each with a lift of about 13 feet. Under this project the upper lock and dam (No. 2) was completed in 1906, and is now in use. The lock walls of the lower lock (No. 1) are also built, but the dam has not yet been commenced. Upon recommendation of the Chief of Engineers, U. S. A., Congress changed the original project to a single lock and dam, with a lift of about 30 feet, this new construction being built at the site of the lower lock and dam.



Looking Down Stream—Government Lock, St. Paul, Minn.

The lower illustration opposite gives a general view of the lock looking up stream toward the cofferdam on the opposite side of the river where the foundations of the dam are being started. The new lock chamber is 80 x 350 feet, the same as in the original project, but the depth over the miter sill is changed from 6 feet to 9 feet and the lift from 13 feet to 30 feet. This required the lowering of the lock floor and the widening and raising of existing walls. The top of the new walls are just 50 feet above the lock floor.

The upper view looks toward the down-stream end of the lock, and in the foreground is the up-stream miter sill which will be under 14 feet of water. This new sill is at about the height of the original wall. All above this level is new construction and may be identified by the square block markings.



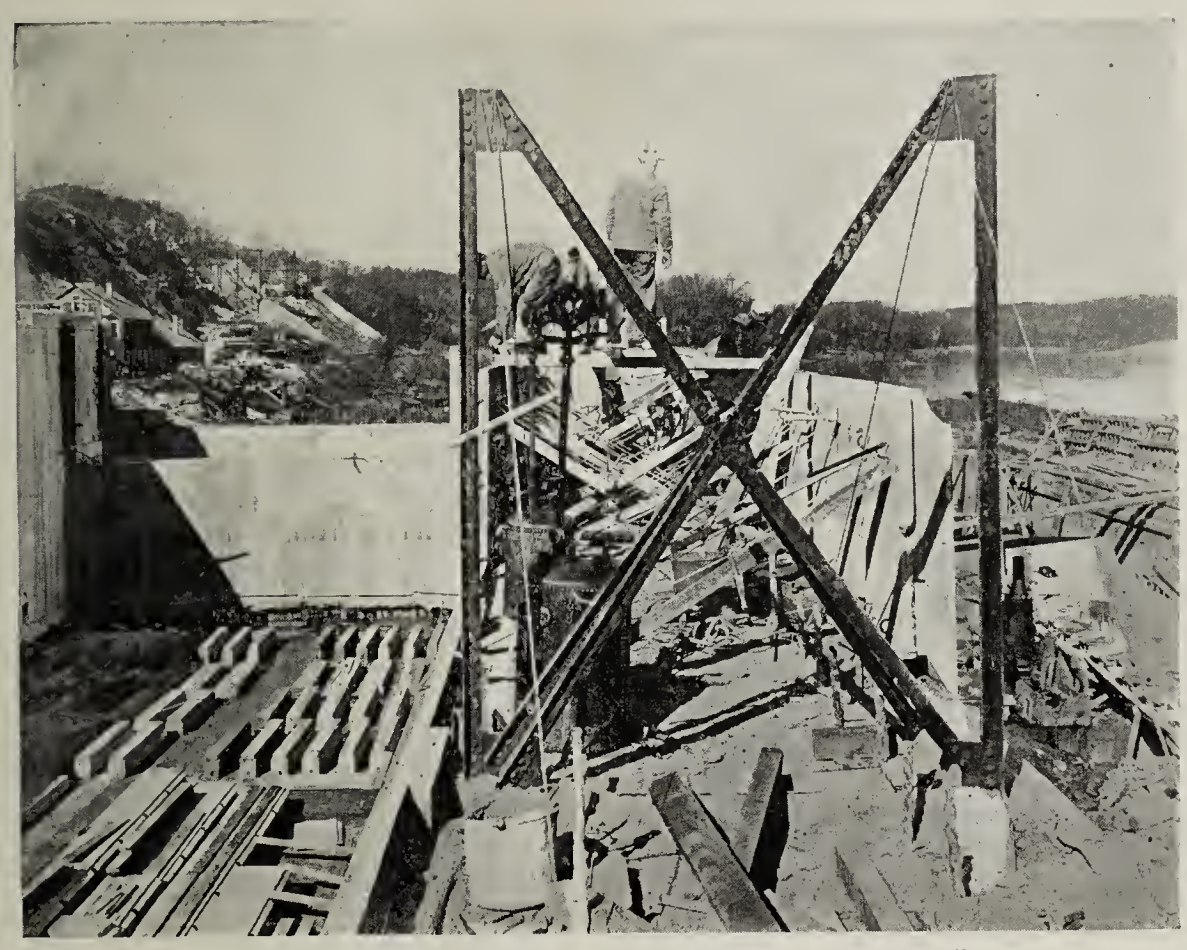
General View of Government Lock and Dam, St. Paul, Minn.

To save the expense and difficulty of placing and removing such high and heavy forms for concreting

as were required for this work, interlocking concrete facing slabs were cast, reinforced with wire mesh and mortar faced. The third illustration shows at close range, the method used. The steel frame in the foreground is one of several used to align the form slabs. At other parts of the work this slab system was used on one side and a truss-supported form system on the other. A steel frame was erected on the sloping side of the wall and planks bolted to the outside of the steel framing. Sufficient space was left between the planks and the steel supports so that when the concrete was placed, all steel work was imbedded in the body of the wall at least 3 inches. These methods of construction were carried out as far as possible, and were found to be most convenient and economical. In the third view at the left, may be seen the foundation for the finished floor, which has yet to be placed.

It is expected that 1914 will see the completion of both lock and dam. There will be in the project not only the lock and dam, but a power house, to be built by private lessors of the power rights which will develop ultimately 15,000 horse power through the high-water season, for approximately 280 days. The cost, it is estimated, will be $431,000, for the locks, and with the dam and power house, will amount to $800,000.

In this work so far, 45,000 barrels of Universal Portland Cement have been used. Lieut. Col. Francis R. Shunk, Corps of Engineers, U. S. A., St. Paul, is in general charge, with George W. Freeman, assistant engineer, in direct supervision.



Erecting Slab Forms at St. Paul (Minn.) Lock and Dam.

BELT CONVEYORS.

The Link Belt Company, Chicago and Philadelphia, will send free of charge to readers of Cement and Engineering News their new booklet on belt conveyors. They have manufactured and installed belt conveyors for cement, gravel, sand, crushed stone, gypsum and plaster mills for twenty years and are furnishing the most efficient and durable equipment today. The "Link-Belt" conveyors have independent lubrication for each roll.

NEW SAND-LIME BRICK PLANT FOR MINNESOTA.

The Range Sand Lime Brick Co., composed of Minneapolis, Duluth and Range capitalists, is erecting at Pengilley, three miles east of Calumet, Minn., on the Duluth, Missabe & N. R. R., a sand-lime brick plant which, when completed, it is said, will be one of the largest and best equipped plants of its kind in the United States.

The plant will be capable of turning out 100,000 bricks per day, and from present indications the output will be sold in advance of the day that the plant is to begin operations. It is planned to have everything in order and ready for operation in sufficient time for the spring trade. The company is also erecting, in connection with the brick plant, a hydraulic plant for the hydrating of lime for their own use as well as the commercial trade in that locality.

CONCRETE FENCE POSTS.

Along the line of the Queen & Crescent Railroad through Kentucky and Tennessee, the old fencing, wood posts and wire netting, is being replaced by new steel fence supported on concrete posts. The expense incidental to a complete renewal of all posts was hardly justifiable in view of the excellent condition of a majority of the posts and renewal has been made only at the corners and every fourth or fifth post. This has given perfect support for the new steel fence and yet has made the present cost of renewal moderate. It will be possible to make further renewals as necessary. The posts are made under factory conditions at one point on the line and shipped as needed to the various points of re-construction.

This is but one of the many concrete improvements along the line of this railroad. A number of their stations—practically all of their newest—are of concrete blocks, with plain face and excellent finish.

The approval by the American Railway Engineering Association of concrete fence posts has led many railroads to begin their use. The Northwestern Steel & Iron Works, 1080 Spring street, Eau Claire, Wis., manufacture a very good mold for making concrete fence posts.

Consistency and Time in Mixing Concrete

By H. F. Porter.

The preparation of concrete is an art, and as such requires painstaking attention to every detail, from the selection of suitable materials to their final deposition in the molds in form for the finished structure.

By no means the least important of the steps is the operation of mixing, wherein the materials for the first time are brought together and by thorough agitation worked into a homogeneous plastic mass.

It goes without gainsay, that the mixing must be thorough and complete, in order to achieve satisfactory results. Indifferent or incomplete mixing will no more turn out good concrete, than scanty stirring good cake dough. The operation must continue until sensibly, the inert and solid particles, fine as well as coarse, are thoroughly coated with the cement cream, and themselves occupy the most intimate relationship one to another possible.

The proper degree of mixing may be gauged simply by the appearance. It is an indication that the operation has continued long enough when the mass assumes a uniform color and a dense, smooth appearance, or, in other words, becomes thick and gruelly.

The amount of water used in mixing, evidently, is of prime importance. This must be adjusted so that the mass on completion of the operation is just the proper consistency. To gauge it to a nicety and keep it right, requires the utmost care and vigilance. This detail, therefore, should be entrusted only to a workman of acuteness and unquestioned reliability.

The value of a good man thoroughly trained to this task, is hard to overestimate. Not only does he become an expert judge of the degree of mixing and the proper consistency, but of the correctness of the proportions. The barometer is not a more accurate gauge of atmospheric conditions, than he of the quality of concrete. Let him once know what good concrete is —concrete correctly proportioned, thoroughly mixed, and of proper consistency—and he will never again be deceived by a "make-believe" or "good enough."

The question of the proper amount of water has already been discussed, but at the risk of repeating some points it will again be taken up. Regardless of theoretical requirements, there should be enough water to thoroughly lubricate the mass, such that when done and ready to place it should be soft enough to flow, but not so soft as to separate.

If there is too much water, the mass will lack coherency, tend to separate; if too little, it will be dry and crumble. Both extremes are bad, but the latter is rather worse, at least from a practical standpoint, than the former. In fact a slight excess is sometimes desirable, and on a practical basis justifiable, for the reason that it facilitates the mixing and placing, the imbedment of steel, and the securance of a smooth surface finish. On the other hand, too dry a mixture not only is more difficult, therefore more expensive, to mix and place, but, in the case of reinforced concrete, lacks the elements essential to a thorough union of the two materials. Not only that, it is deficient in strength and density, and is far more liable to disintegrating influences. Too wet a mixture is also deficient in strength and density, although not in the same degree as too dry; it is the lesser of two evils.

Quoting from Bulletin 344, of the U. S. Geological Survey: "The tests lead to the belief that the tensile and compressive strength are alike affected by both age and consistency. . . . The effect on the strength of the variation in consistency is clearly shown. *In almost every case the concrete of the damp consistency is the strongest and that of the wet consistency the weakest.* . . . Attention is called to the fact that the damp consistency used was much wetter than that used in making mortar building blocks, for which the same conclusions may not apply.

"The effect of the consistency on the strength seems to depend to a great extent on the behavior of the concrete while being tamped to the method used in tamping. Great care was taken to tamp all the concrete in the same manner.

"The thorough mixing of the concrete is absolutely essential and has a marked influence on the consistency.

"While it is true that in almost every instance the drier mixtures give the greater strength, it does not follow that dry (or damp) mixtures should be used in construction. Practical considerations warrant the use of a wet mixture. The difficulty in securing efficient tamping and a smooth finish in a damp concrete, the loss of strength due to the unavoidable drying out of the concrete used above water, the difficulty of securing in reinforced concrete an intimate union with the steel, and the far greater ease of placing wet concrete all seem to warrant the sacrifice of what in many cases is but a slight difference in strength for a greater ease of manipulation and a thorough bedding of the steel, which is of the utmost importance in reinforced concrete work."

The concurrence of the foregoing conclusions with the foregoing remarks is obvious, chiefly as follows:

1. The strength is affected directly and considerably by the consistency; and

2. The consistency is markedly affected by the thoroughness of the mixing.

The utmost care must be taken to see that these requirements are met.

There is another very practical way of testing the consistency. It should be such that the concrete will flow through a chute or closed channel freely and yet without separating. If too dry it will be found to clog up in the channel, to pile up on the chute and if it moves at all to crumble and roll in parts. If too wet it will be found to separate. These are facts of prime importance, and have a vital bearing on the economics of concrete construction. There is little question but that, eventually, concrete will be distributed entirely in this manner, making use of the principle of flow of liquids. It is thus that Thomas Edison proposes to cast houses in one operation of pouring. Moreover, the practicability and economy of this method for ordinary construction has already been demonstrated, in the case of the Christian Science Church in Los Angeles, California, completed in 1909, which is entirely of concrete, the material having been placed in the moulds by means of a flexible pipe system operating from a central tower. Not only were marked economies hereby effected, but a far more homogeneous concrete, of greater strength and more uniform appearance, was secured. It was found on this job that the mixing must be thorough and the consistency proper, else the concrete would not work properly; if too dry it would clog the pipe; if too wet, it would separate; only when just right would it flow through the pipe easily. Considerable time was saved in placing, which made possible the handling of the material without running the risk of premature induration. Thus, in every way, maximum efficiency was found to be coincident with maximum economy.

As to the value of thorough mixing, data quoted from the Watertown Arsenal Report for 1911, page 154, under the caption—"Effect of Mechanical Agitation and Regaging," are pertinent. Continuous agitation of the mix for two hours is seen to have increased the strength nearly 20 per cent. over the strength after the first few minutes of mixing, such as is ordinarily considered adequate. Further continuation, however, of the operation is seen to have been attended by a progressive falling off in strength. The inference is, that the mixing, while it needs be thorough, at the same time must be expedited as much as possible, in order not to encroach upon the periods of crystallization. While the effects of continuous agitation is, undoubtedly, to postpone the setting, nevertheless there must ensue a period when the setting can not longer be delayed without injury to the product. Thus there is the danger of overmixing, as well as under-mixing. Of course, there is little likelihood of this extreme occuring in practice, unless exceptionably, by accident. On the contrary, the likelihood is almost entirely the other way: the great difficulty with all concrete work is to have the mixing done thoroughly enough, the temptation is strong to make haste at the expense of thoroughness of mixing. Still, over-mixing is a contingency with which, on occasion, to reckon. Such is the situation, when, perforce of unexpected circumstances, the charge in a concrete mixer cannot be taken away and distributed for a considerable length of time. The question is—How long may a batch of materials continue to be revolved in a machine without suffering serious loss of strength?

The writer once had an experience which bears directly upon this point. It so happened on a certain job that the noon hour found the concrete mixer charged, and the foreman, instead of working a few minutes overtime in order to dispose of the charge, allowed it to remain, but kept the machinery going. The writer, arriving on the scene shortly afterwards, while the men were at lunch, discovered the condition of affairs and promptly forbade the use of this batch. Contrary to his instructions, however, while he was on another part of the work, it was hoisted to the floor, and he returned to the spot just in time to intercept it. He ordered it cast aside upon a portion of the floor placed some days before and already fairly hard. He supposed that it had been ruined by the protracted agitation. Much was his surprise, therefore, and the foreman's delight, to find the discarded concrete flint-hard the next day, and adhering so tightly to the floor slab as to require painstaking picking to remove. Moreover it was the smoothest and densest appearing concrete, and the most uniform in color and texture, of any concrete he had seen in practice. His one regret was that a sample had not been secured for a strength test. This was several years ago. Since then examples and experiments have multiplied to corroborate the writer's observations, and to establish the wisdom of much more thorough mixing than has, in times past, been the practice.

Perhaps the most valuable data bearing on this point—as to the effect on the strength of thoroughness of mixing, aside from the report of the Watertown Arsenal previously quoted—is that obtained by C. G. Streels, assistant city engineer, Sioux City, Iowa, which are herewith given:

Results of tests made in 1902, on effect of continuous mixing of Portland cement mortars, by C. G. Streels, assistant city engineer, Sioux City.

Sand through sieve of 20-meshes per lin. inch and retained on sieve with 30-meshes per lin. inch; 99 oz. of cement, 220 oz. of sand and 24 oz. of water, or 7.77 per cent. of the cement and sand.

No. of briquets in lot.	Continuously mixed for Hrs.	Mins.	Tensile Strength per. sq. in.
4	0	15	294
2	0	30	278
2	0	45	282
2	1	00	243*
2	1	25	275
2	1	55	283
2	2	25	287*
2	2	55	314
2	3	25	326*
2	3	55	372
2	4	25	334†
2	4	55	384
2	5	25	264
2	6	25	308*
2	7	25	217
2	8	25	255
4	8	55	246
4	8	55	220*
2	8	55	215*

* 2 oz. water added. † 3 oz. water added.

All of the above samples, it will be observed, were mixed much more thoroughly than is the average current practice. A batch that receives more than 5 minutes turning, at the most, is a rare occurrence, and an accident rather than an intention. The series had been of more value, apropos of the present discussion, if results had been obtained for short-time mixings—under 15 minutes, the minimum given in the table. Maximum results are seen to have been obtained between 4 and 3 hours, which is about twice as long as found beneficial in the Watertown tests. This difference, no doubt, is due to the amount of water used in the mixing and the brand of cement. As far as practical indications are concerned, however, the two observations are in accord: both emphasize the necessity for thorough mixing. The time element involved is immaterial. The fact remains that the mixing must be done properly, whether it takes 5 minutes or 5 hours, and if a machine is available that will do the work in 1 minute, so much the better.

SANDSTONE BRICK.

The Alsip Sandstone Brick Co., Ltd., Winnipeg, Manitoba have acquired the rights to use the Komnick system in the production of brick. This system is being used to great advantage in Germany, Eastern Canada and the United States. The machinery used is the latest and best on the continent, and has a capacity of 88,000 brick daily. Six points in favor of sandstone which are worthy of mention are claimed by the company: Looks— being uniform in size you do away with the ugly uneven mortar joint and get in its place a nice even joint which is always pleasing to the eye; fire—excellent are the results of fire tests. Brick which have been heated to a white heat and plunged into cold water have come out of this severe test as good as they went in. What other brick will stand this test? Strength—They have had repeated tests as to the strength of their brick, with the result that they will stand an average pressure of 73,000 pounds. Absorption—After repeated tests they find their sandstone brick does not absorb as much water as the common clay brick. Cost of laying—Is considerably cheaper than laying common brock. Mortar is more expensive than brick; therefore you will not use as much mortar, because of its uniform size.

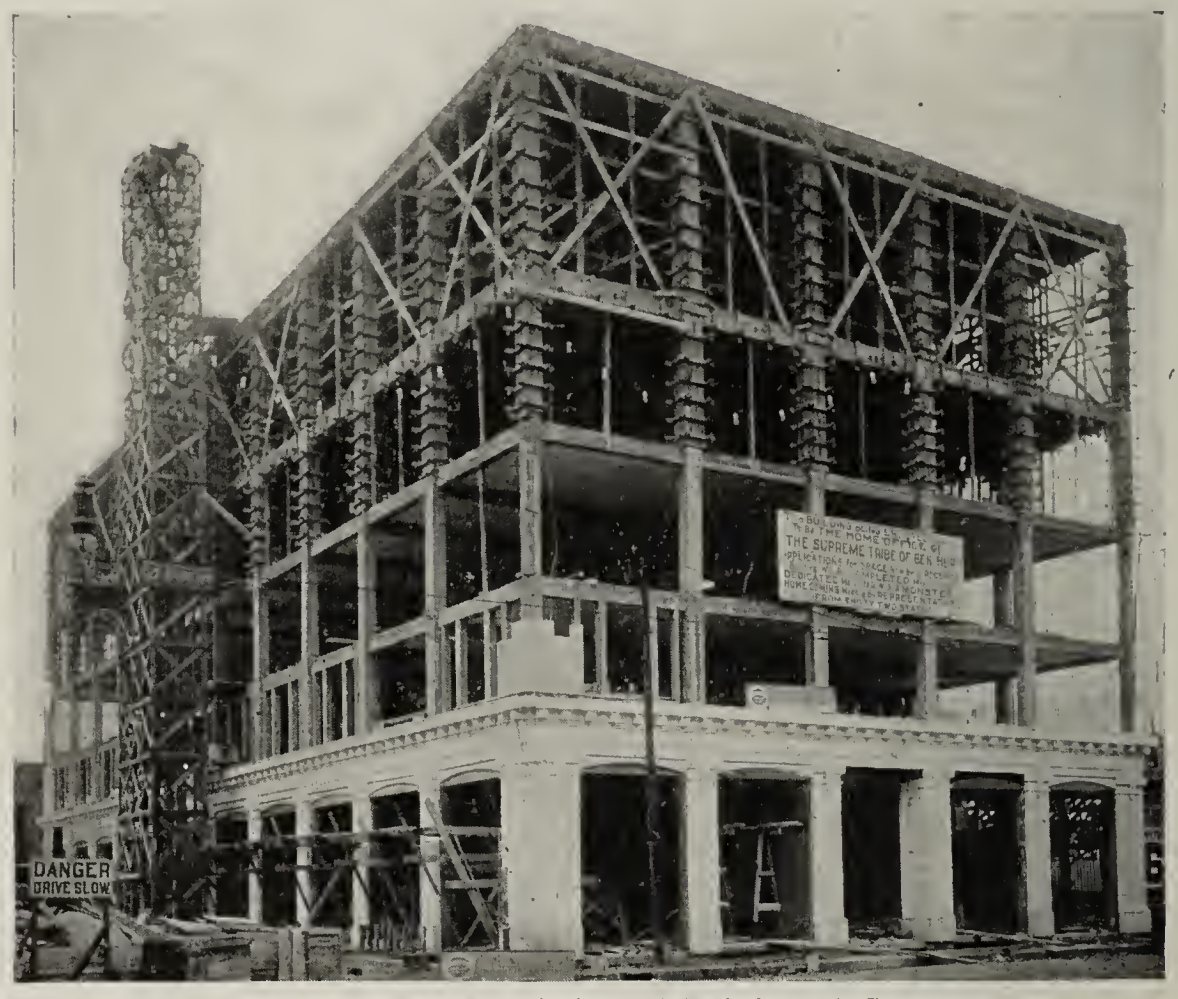
CONCRETE WATER TOWER IN HOLLAND.

A reinforced concrete water tower has been built in Leyden, Holland, which is described as follows:

In designing a water tank of about 300,000 gallons capacity, elevated on a tower about 65 feet high, it was first intended to make a tower of brick and the tank of iron. On receiving bids on this design and one for reinforced concrete, however, the latter was found to be much cheaper, the bid being $22,500 against $28,000 for the brick and iron construction. The reinforced concrete construction was therefore adopted.

The tower consists of 12 reinforced concrete pillars connected by two sets of horizontal braces. The spaces between the columns and the horizontal braces are arched under surface which do not meet in the center but abut against a ring of concrete under the center of the tank. On the outer side of each column is constructed a bracket 1.3 feet thick, and these brackets and the arched girders before mentioned serve to support the tank. The tank is cylindrical, 46 feet in diameter and 26 feet high. The bottom of the tank has a thickness of 0.95 feet, and the walls are 0.99 feet thick near the bottom and 0.33 feet at the top. Both sides and bottom are reinforced. In order to protect the tank from temperture contraction and expansion it is inclosed by an outer wall or tank which is constructed of 12 reinforced concrete columns, each standing on the outer end of one of the brackets, which columns are connected at top and bottom by concrete beams, the rest of the space between being filled with brick work. The top is covered with a flat roof, in which is placed wire glass which serves to admit light into the tank. The balance of the roof is covered with a waterproof mastic and gravel and a low wall is carried entirely around the outer edge. Three lightning rods are provided on the roof.

A vertical concrete box is carried up in the center of the tower from the ground to the under side of the tank, which contains and protects the supply, drain and overflow pipes. This is rectangular in form and rests on 21 piles. Just outside of this are four columns extending from the ground to the under side of the tank, which serve as supports for a reinforced concrete stairway. These posts are connected at various



Lodge and Office Building of Reinforced Concrete.

Delegates from thirty-two states convened last March for the dedication of their new home of the Supreme Tribe of Ben Hur at Crawfordsville, Ind. The building is a five-story structure, 65x100 feet, of reinforced concrete frame and floors, and will be used partly for stores and offices.

It is probably the first lodge home to be built of reinforced concrete. The exterior will be faced with terra cotta and pressed brick. The interior will have a partition of hollow tile and be finished in mahogany and red gum, with mosaic floors in corridors and maple floors elsewhere.

H. L. Bass & Co., Indianapolis, are the architects, and W. C. Carr & Son, of Crawfordsville, are the engineers and general contractors.

heights by strong tie-beams. Near the top the stairway ends in a platform and is continued by suppplementary stairs leading to the space between the shells of the tank and the enclosing structure. From this point access is had to the top of the tank by means of an iron ladder, which is suspended in this annular space from an iron rail carried around the top of the inner tank, which rail also carries a ladder inside of the tank. These ladders travel on this rail and can be pushed entirely around the tank, thus giving access to any portion of the inner or outer surface. A float with connection from the same to a valve at the top of the inlet pipe automatically shuts off the water when the tanks has been filled to the desired level.

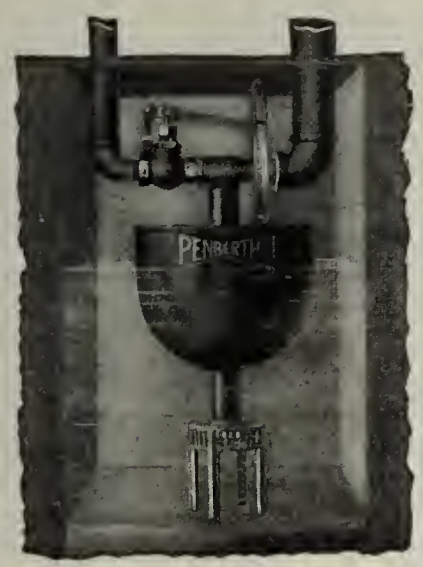
The concrete foundation ring is strongly reinforced, both longitudinally and in cross-section. The main columns have vertical reinforcements which are tied together with round iron hoops.

An effort was made to give a pleasing appearance to the tower. The concrete surfaces are finished with a coat imitating sandstone, and the brick work, while flat, is varied in coloring, the bottom being dark, the panels at mid-height being red, and the top brown.

PENBERTHY CELLAR DRAINER.

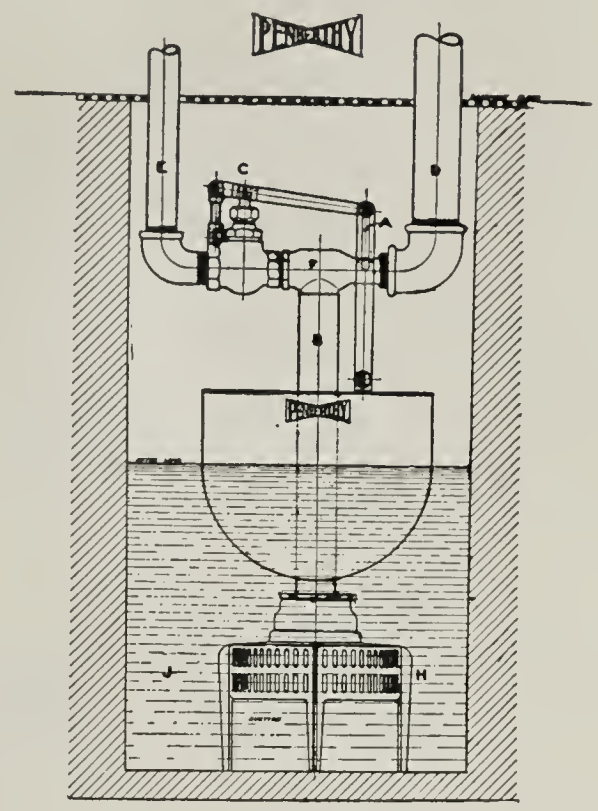
The PENBERTHY Automatic Cellar Drainer is a Penberthy water pressure ejector of high capacity automatically operated by a float-controlled, quick-opening-and-closing valve C. This valve is never partially opened—it cannot leak, and allows the ejector to give its greatest efficiency by working to full capacity.

The float arms are slotted at A. where they connect to the valve lever C—this prevents the ejector from operating until the water has raised the float up to the highest point, and, as the water is ejected, they



travel down the length of these slots before the weight of the float effects the valve. This allows the machine to work for longer periods and not so often, thus preventing considerable wear and the leakage and dribbling of water, as is common in the majority of drainers.

To enable the installation of this drainer in small holes, or sumps, we have made it as compact as possible. The float, instead of being round, is flat on the top; it has more buoyancy and occupies less space than a round float of the same diameter. We have further economized on space by building the float around the suction pipe B. This patented feature has the added advantage of being rigid and overcomes all the trouble of the common loose float. The balance of the drainer is built directly above the float; this not only keeps the whole machine in as small a space as possible, but also keeps all working parts with the exception of the strainer and float, above the water, thus preventing corrosion or the exterior parts becoming clogged up by deposits of slime, dirt, or sediment. The interior parts are prevented from coming in contact with any foreign particles by the special strainer H, which is so constructed that instead of the water



being drawn directly upward it is taken in at the sides, allowing all sediment to collect under the strainer without being disturbed by the force of the suction. We also provide a foot valve inside the strainer which closes the instant the drainer ceases operating holding all water in the pipes, all primed for starting instantly, at the next filling of the sump.

The Penberthy Automatic Cellar Drainer is particularly adapted for use in pits, sumps, cellars, tanks, settling basins, or wherever it is desired to keep water or other liquids from going above a certain level. It is more efficient, takes up less room, will last much longer, and sells at lower price than asked for many drainers not as efficient. They are made of best bronze metal, except the float which is copper—can be regulated for any water pressure.

CONCRETE ELEVATORS.

"Concrete in Grain Elevator Construction" is the title of a new pamphlet issued by the Universal Portland Cement Co. The work is illustrated by views of a number of reinforced concrete grain elevators and warehouses and the text is devoted to a discussion of the following topics: First Cost, Depreciation, Insurance (Building-Contents), Vermin Losses, Fire Protection, Business Insurance and Conclusion. The conclusion is recited in the following extract from the work:

"It can readily be seen that in a period of from four years as a minimum to eight years as a maximum, with figures based on the above, the concrete construction has paid for the difference in cost, and at the end of that period the money that would each year be sunk in depreciation and insurance, the dealer can then charge up to the credit sheet in his ledger. This sum, amounting to about $500 per annum, would materially assist in showing a handsome profit in his business. This is not all. He has a building which has grown better and stronger as the years have passed, and to which he can economically make such additions as the growth of his business warrants."

LARGE CAPACITY STONE DERRICK.

The illustration herewith is of one of the largest derricks now in use in New York for the purpose of loading heavy stones. The capacity is forty tons, and the length of the boom is sixty feet. The construction throughout is especially stiff and strong, without extra weight. A derrick to be installed on a barge should, of course, be as light as possible, this feature being more necessary here than for ordinary uses where the derrick is to be operated on the ground.

The derrick shown herewith was built by the Hind Hoisting Machinery Co., of Buffalo, N. Y., which is one of the largest concerns in that city manufacturing hoisting machinery for contractors, railways, etc.

Mr. Wm. M. Hind, president of the company, was employed for a number of years as superintendent for the Contractors' Plant Co. of Buffalo.

The Hind Hoisting Machinery Co. recently purchased the plant formerly occupied by the Riverview Bronze & Manufacturing Co. This addition to the plant gives excellent facilities for the manufacture of standard and specially designed hoisting machinery and contractors' equipment.

Large Stone Derrick Built by Hind Hoisting Machinery Co.

TYPICAL TILE PLANT UNIT.

As a typical unit for a cement tile plant, the W. E. Dunn Manufacturing Company of Chicago, suggests one Dunn tile machine and three men. One man does the mixing (by hand or with a mixer) and keeps the table back of the machine filled. The second man operates the machine as follows: puts in empty casing, pulls material into casing, trips the foot lever, and takes out the tile (enclosed in the casing) ready for the stripper. The third man takes tile to the racks and strips the casing. These three men with a Dunn machine will turn out 1,800 tile per day of ten hours.

A 6-inch tile is an average size on which to estimate the profits in this business. Smaller sizes will not show as much profit, but the sizes above six inch will show much more.

A 6-inch tile can be made on the average of $16.66 per thousand. They sell on an average of $30.00 per thousand, leaving you a profit of $13.34 per thousand. On a day's output with a Dunn machine and three men, your profit would be $24.00. This is arrived at as follows:

11	bbls. cement, @ $1.50 per bbl.....	$16.50
6¾	yards sand, @ $0.75 per yard.....	5.00
3	men, @ $2.00 per day.....	6.00
	Power and incidentals, per day.....	2.50
	Total cost of 1,800 six-inch tile....	$30.00
	Average selling price is $30.00 per thousand.	
	This for 1,800 tile would be.....	$54.00
	Total manufacturing cost.....	30.00
	Profit per day, or on 1,800 tile.....	$24.00

CONCRETE WORK IN PITTSBURGH.

Enormous quantities of concrete are being used in the great scheme of improvements which is being carried forward by the city of Pittsburgh in the matter of flood prevention. In this connection the city has made extensive improvements in street-raising along the Allegheny, Monongahela and Ohio rivers. Streets in the lower section of the former city of Allegheny have been raised by fills that in some instances attain a height of 11 feet.

Municipal work is now under way in the West End district of the ctiy, where the streets along the Monongahela and Ohio rivers are being raised from one to fifteen feet. All the walls are of concrete. All important sewers, heretofore constructed of brick, are being reconstructed of concrete, and over one stretch of ground a concrete wall is being built one and one-half miles long.

Concrete is being used in other extensive municipal improvements also. Among these is the work in the elimination of the Try street grade crossing over the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad. This undertaking involves the expenditure of $600,000. Practically all the material used is concrete,

including the erection of retaining walls and the laying of sewer mains.

A new concrete bridge with a concrete approach is now under construction at Murray avenue and William Pitt boulevard. At this point an old frame bridge crosses the boulevard 600 feet above the latter thoroughfare. This is being supplemented by a concrete arch. The Atherton avenue bridge is another important piece of concrete work. In the rehabilitation of the Point bridge spanning the Monongahela immense quantities of concrete are called for. The old bridge is being razed and many of the old piers are being supplemented by new, owing to cracks in the old pier structure.

CONCRETE POLES.

The objections urged against Reinforced Cement Poles, as compared with iron, are, that the reinforcement is hard to hold in place, difficult to anchor within the molds and a tendency to separate the reinforcement from the concrete by any uneven strain or swaying of the pole, the whole construction requiring much skilled labor in both bonding the reinforcement and tamping of the concrete.

In ordinary construction, round or square bar iron is employed for the uprights which are bonded or held together by wire wound in coils and tied to the uprights, at frequent intervals, or woven in sections with hinged joints. All this must be performed by skilled hand labor on the ground where the pole is to be set, except in fence posts or very light construction, making the preparation very expensive. *There is no method or system now in use, for holding the reinforcement centrally within the molds,* other than with wooden cleats which weaken the pole and deprive it of uniformity. The "pouring" and "tamping" of necessity require great care to avoid disarranging the bands or ties which lack rigidity in any method of permanent attachment with the uprights.

All this is overcome by the Rubello-Santi System, as the reinforcement is rigidly held in position as though it were one piece. The concrete may be applied, either in an upright position for very large poles, or in horizontal position for smaller poles, with absolutely no danger of misplacing the reinforcement. This kind of reinforcement is adaptable to either solid or hollow poles.

To provide for the steps or climbing cleats, the most economical method is that of placing greased pins of correct diameter, in the sides of the pole, and withdrawing them before removing from the mold. In the holes so formed, the necessary steel steps can be inserted when the pole is ready for erection, by slightly bending them where they are to be permanently fixed in the pole, by setting them with a thin mortar of cement and sand, or some similar substance. This saves a large cost in forms and time arranging cover-up slips for the slots and eliminates all danger of the steps breaking out of the concrete while removing or handling. For safety and convenience, as well as protection against damage, it is more economical to place the steps after the poles are cured, or possibly after they are set up.

One very important feature of the Rubello-Santi patent, is that of the spacing-reinforcing rings or squares. *They hold rigidly and at predetermined distance,* the whole reinforcement (rods and rings) from the walls of the mold, producing a uniformity of concrete surrounding the reinforcement, with a corresponding uniformity of strength capable of withstanding a strain from any direction. These rings have an *intense binding effect* which reinforces the concrete, and precludes it from crushing out or shelling off.

The Standard Cement Pole Company of America who owns and controls the Rubello-Santi System, under its letter patent relating to reinforced concrete cement construction for hollow poles, brings the cement pole into practical marketable condition.

In these poles, the reinforcing members consist of a plurality of metallic rings embedded concentrically in the concrete, and variably interspaced all the rings being united by steel rods which run parallel through a number of perforations with which the rings are provided. These rods taper toward one end of the pole where, as is usual, a somewhat conical form is desired. These spacing rings which are preferably made of cast iron, are provided around their circumferences with equidistant integral spherical protuberances or knobs. The latter are provided with openings or perforations to permit the passage there—through of the space rods. These rings so constructed are economical in manufacture and permit a slight and slender skeleton frame to be made with adequate strength and stability. At occasional points around the peripheries or outer space of the rings as, for instance, at four points in the diameters at right angles to each other in the circumference, the knobs or protuberances are extended radially to form tapered pins or spikes of equal length, these spikes or pins acting as additional reinforcing elements and a means of centering for the whole reinforcing structure in the pole.

TOPEKA IS FAST GROWING SAND DISTRIBUTING CENTER.

Topeka is one of the greatest sand distributing centers in the central west. The industry is growing. The sand along the Kaw is said to be of superior quality, and hence the heavy demand on the part of builders. When the local plants are working at full capacity and the orders are coming in particularly rapidly, as many as fifty carloads of sand are sent out to all parts of Kansas and even into Nebraska.

The city consumption on the part of builders and others is often as high as several hundred loads a day. This is used in construction work of all kinds, including the laying of paving and concrete walks.

It is interesting to go down to the river and note the different methods that are employed in lifting the sand from the bed of the Kaw. The Topeka Sand Company at the foot of Topeka avenue has recently installed the latest system of sand handling machinery. Through the means of a powerful motor and a centrifugal pump the water ground stone from under the waters is lifted to an elevation of 45 feet into a drainage bin just south of the dike.

From this bin cars are loaded at an average speed of one in 15 minutes. The motor is in sort of a house boat.

The barge method of obtaining the sand is used by the Southwestern Sand Company, which has its headquarters near the foot of Madison street. There are a number of sand scows that make their way to an adjacent sand bar, and through the means of a steam lifting apparatus are loaded; then they return to the river bank where the sand is unloaded. There are several other firms in operation including the F. D. Fowler concern, the Wear Sand Company and the T. W. Wadsworth firm.

10,000 TON REINFORCED CONCRETE COAL POCKET.

The 10,000 ton reinforced concrete coal pocket of the Pacific Mills Print Works, located on the south bank of the Merrimac River at South Lawrence, Mass., is nearing completion and is probably one of the largest coal pockets ever built of concrete. The coal pocket was constructed by the Aberthaw Construction Co., Boston, in accordance with the design of Lockwood, Greene & Co., of the same city. The work was carried on through the severely cold winter, necessary precautions having been taken for insuring satisfactory results. It extends 119 ft. 7 in. to the east of the boiler house and is 153 ft. 3 in. in length, with a partially glazed monitor running its length on the western side and over the coal conveyor delivery. The roof is of 5-ply tar and gravel on 3-in. plank supported by 7¾-in. square pine columns with 8 by 12 in. and 10 by 1+ in. pine columns.

The concrete piers rest on Simplex concrete piles. In the basement there are six longitudinal rows of 37-inch diameter reinforced concrete columns spaced

generally 16 ft. 9 in. on centers. These columns support the heavy buttresses of the coal pocket floor, which slopes from each column down to the cast iron thimbles through which the coal is discharged to the cars running on the industrial tracks in basement below. The coal pocket proper is about equally divided lengthwise by a concrete wall and it is divided across in thirds by two other concrete walls.

The coal is received from the railroad cars that run over a hopper located at the southwest end of the pocket. After passing through the hopper the coal goes through a Hunt coal cracker and is automatically emptied into buckets of a Hunt noiseless conveyor system and then taken immediately up to the roof. The conveyor driver is operated by motor. On reaching the roof the coal may be distributed in two ways. If it is desired for the two west side pockets, the coal from which is to be used daily, the buckets are tipped as they reach the proper set of double-sided chutes, eight sets running lengthwise. For the other pockets the buckets run to the north end and there are tripped into a large hopper that fills a car running on an industrial track extending across the building with four branches that go over the other pockets that are used for storage purposes.

In the basement are seven industrial tracks running lengthwise and converging into a main track to the boiler house. The C. W. Hunt Co. furnished all the coal-handling machinery according to specifications of Lockwood, Greene & Co.

METHOD OF PATCHING AND PREPARING CONCRETE.

An interesting investigation of current practice in patching and repairing plain and reinforced concrete to determine the most satisfactory and practical methods has been made during the past year by the committee on masonry of the American Railway Engineering Association and embodied in a recent report of the Association. Several methods reported to be in use are described by the committee and comment on their usefulness is made as result of replies received to the circulars sent out. In the following will be found the conclusions drawn by the committee as to the various methods of doing this kind of work.

Wet Method.

The surface of the old concrete is thoroughly roughened, cleaned and drenched with water and covered with a cement grout. Then the new concrete is mixed to a sloppy consistency and applied, being held in place until set by forms. It appears that many successes and many failures have followed this method. Where it has been successful, it is believed that the result probably has been due to painstaking care and expense being employed in the preliminary cleaning and thorough wetting of the old concrete surfaces before the new concrete is applied.

Moderately Dry Method.

The surface of the old concrete is thoroughly roughened, cleaned and drenched with water and powdered with cement or painted with cement grout, after which the new concrete is applied and thoroughly tamped against the old surface. Generally such patches are kept moist by sprinkling with water for several days. The same comment is made on this method as on the wet method.

Dowel Method.

This is a modification of the two preceding and is generally used for other than horizontal surfaces, although it may be applied to the latter. The new concrete may have any consistency to meet the particular conditions or the ideas of the engineer, but usually a fairly wet concrete is used. This method includes drilling holes and setting dowels into the old concrete, with projecting ends to engage the new concrete. Some time steel bars or metal fabric are connected to the dowels to insure permanency of the patch. The committee observes that this method can be made uniformly successful but can not always be applied. Where any considerable mass of concrete is to be connected to concrete it is believed to be the only safe method.

ADVANCE IN STEAM SHOVEL DIPPER CONSTRUCTION.

A noteworthy improvement in the design and construction of steam shovel dippers has been made by the Edgar Allen American Manganese Steel Company of Chicago, Illinois, manufacturers of "STAG" Brand Manganese Steel Castings. The dippers made by them are known as the "Missabe" Dippers, and have already proven to be eminently successful. The first three made were put in service on the Panama Canal about one year ago, and since then several of the largest operators in this country have adopted them. Every one in use is reported to be standing up in fine shape, and bears out fully the builders' claims for durability and efficiency.

Many of the most valuable features are covered by patents.

Every part of the "Missabe" Dipper, including the back, is of cast manganese steel. This fact alone in-

sures great durability and a minimum cost in repairs, owing to the remarkable toughness and wearing quality of the metal.

The design also is considerably in advance of the other dippers, and to it is due much of the success attained.

The dipper body is composed of only two castings—the front and back halves. This gives great rigidity and eliminates the working and straining of the parts which, in the old style dipper built up of plates, causes loosening of rivets and frequent repairs.

The bail brackets are set at an angle conforming to the line of pull on the bail, and by putting them against projecting shoulders cast on the sides of the front casting the shearing strain is relieved from the bail bracket rivets. See cut.

Another remarkably good feature is the placing of the joint, between the front and back casting, behind the bail bracket so that the digging strain does not tend to pull the dipper apart.

The teeth are riveted on as usual, but are held unusually rigid by means of notches in the lip and shelf or offset on the outside of the lip, upon which rests

that portion of the tooth which is on the outside of the lip.

When extra protection for the front of the dipper is desired, a renewable bottom band as well as runners or shoes will be furnished when desired, or they may be cast integrally with the dipper front.

All pin holes in bails, hinge brackets and dipper stick brackets are provided with renewable bushings.

Where a shovel is of high power and the digging is such as to throw great strain on the dipper it would seem that the "Missabe" Dipper would give wonderfully efficient and economical results which heretofore have been unobtainable.

This dipper is built in all sizes for the various makes of steam shovels and dipper dredges, and is claimed by the manufacturers to have a life of three or four times that of the built up types.

CONCRETE ROADWAY.

The Universal Portland Cement Co. has obtained permission from the Minnesota State Agricultural Society to lay a section of concrete roadway upon the State Fair Grounds at Hamline, Minn. A section 200 feet long will be laid, following the type adopted in Wayne Co., Michigan. A plain, one-course concrete pavement is to be laid. The Minnesota State Fair is perhaps the most largely attended of any State Fair and the purpose of the exhibit is to show the farmers that country roads can permanently be improved with concrete at a comparatively low cost.

CREDITS BASED ON CONTRACTORS' COSTS.

In spite of the large field for the placing of loans, and business offered by contracting work, there is a strong reluctance on the part of banks and business houses to extend credit to contractors, according to William H. Nye, writing in a recent issue of the *Banker and Investor Magazine*. Continuing, he says:

One of the reasons why it is not possible for the contractor to get credit on his future business is that of the lack of any standard condition in his business. A large amount of business may mean a huge loss instead of a profit. His great safeguard against a loss must be by keeping himself informed continuously about the financial result of his work. This is what the most progressive contractors are doing.

The job-cost systems used at the present time vary greatly. Some contractors keep accounts that show at the close of a job whether a profit or loss has resulted. Others have systems of cost covering each floor of a building or some similar physical unit of work. The contractors who are most accurate in their financial supervision of the work have reports that show daily cost in detail. Each item of the work, like masonry, structural steel, and carpentry, is divided into different classes. Units for each class are established: for brick-work it is a thousand brick, on steel the tonnage, and on carpentry different units, to fit the class of work. These, as a rule, are exactly the items that the contractor estimated upon when he made his bid. Therefore, he has figures to show him how his work is progressing, and if there is any failure to accomplish the results expected he knows exactly at what points to bend his energies for a betterment in conditions.

It might be well to explain here just how these costs are obtained. For example, we will take the method employed by one of the concrete construction companies in New York. Its costs are based on the two items of labor and material, which are kept separately.

The labor costs are found by an accurate system of timekeeping for payroll purposes. The job timekeeper is provided with a list of the various items upon which costs are to be kept. To facilitate this work and to insure its accuracy he is provided with a time-book ruled with columns for each of these items so that the hours that a man spends at each kind of work can be noted opposite his name and number. The timekeeper is required to check his men every two hours, and to show units of time as small as a half hour. As a rule a man is not on more than two or three kinds of work in a day, but to make a correct division of the time doubly certain the sub-foremen are required to be familiar enough with the work to inform the timekeeper just what his men have done for each two-hour period. A daily report of this labor distribution is sent to the office.

In conjunction with this time report a daily progress report, showing exactly the quantities of material used, the amount of each kind of form work placed, the yardage of concrete, and various other items of work completed, is sent to the general superintendent of construction. This report and the time report are used by the accounting department to obtain the unit of costs of the completed work. This cost record shows separately the time for mechanics and laborers on each item of the work. And these items, in their turn, are subdivided into classes of work, so that the final analysis shows two groups of two or three men just where the work is costing more or less than the estimate. From the daily reports sent to the general superintendent a material clerk checks the quantities of material used against the amount of work completed. From these two reports the executive branch of

the firm can tell from day to day the exact financial status of the completed work.

Concrete work affords probably the best type of construction for a standardization of construction methods and a uniform cost system. The company referred to has so perfected its methods that the erection of the plant, the building of the form work, and the fabricating of the reinforcement are typical from job to job. This, of course, makes it possible to have an established set of items on which costs are to be obtained on every building. No such uniformity of methods of construction or cost systems is practical in the general contracting business, where with a single firm the work may run from country residence work to bridges or tunnels in the course of a single year. The best way to take care of such a range of items is to have the time costs distributed to the items upon which estimates were made, and let the material costs cover some systematized physical unit.

There is no business where the men in charge of work have the opportunity for personal achievement equal to that in construction work. The whole field is open to them to show initiative, executive ability, and the power to get work from men. In business houses of established methods and fixed customs the superintendents or managers have certain routine methods to follow. On building work the superintendent, should he formulate some plan of construction that promises to achieve a better result, may put his plan into operation within a few minutes after he comes to the work. The knowledge that the costs are not meeting the estimate often brings about just such a radical change.

No better example of this can be cited than one instance that happened in the early days of concrete building construction. It was the custom at that time to build up a set of forms in the same manner that each story of a house was built. While the concrete that had been poured in these forms was gaining sufficient strength to allow the removal of the forms, another complete set of forms was built in the same manner for the next story. By the time that the second set of forms was filled workmen began removing the first set, board at a time, carefully saving the lumber to use for a third story of forms. Cost keeping at that time was not perfected to the stage that it is now, but it was evident that the money spent for carpentry labor and lumber was too great to allow a continuation of such methods at a profit. No criticism could be made of the manner in which the carpenters were supervised, for the foreman was getting full efficiency from his men. One thing did stand out—contractors were losing money—and that must be avoided in some way. With this necessity staring them in the face, all members of the organization started to devise a plan by which the cost on this work could be reduced. The first step was to build the forms in removable sections to save the expensive task of pulling the forms to pieces, and the more expensive task of rebuilding them. This single improvement so lessened the cost of form work that in spite of losses at the start of the job the final cost on form work showed a profit greater than had been expected in the original estimate. The far-reaching result of this step is that now concrete buildings of ten and twelve stories are built, using over and over the same forms with no reconstruction.

General contracting outside of the huge structural steel buildings in cities is very diversified and seldom admits of type work throughout a job. It is in this branch that initiative on the part of those supervising the work is most often demanded. The details of the work are so many and the length of time that a gang can be kept on one class of work so short that a very efficient organization of the work is not easily brought about. It is here that costs are most necessary. It is not uncommon, therefore, for daily costs to be made up on the job. This information from day to day enables the superintendent to know during the actual progress of the work on certain items whether he is running behind or making money. And if he is running behind he has the opportunity of planning better methods for the work or discharging inefficient men before the work is completed.

In the matter of financing his work, however, the contractor finds a difficulty that he can accurately estimate. He goes to the banks and to the various supply dealers seeking credit on his various jobs. They, as a rule, will allow him credit on the assets shown by his books after careful examination. They are loath to give further credit, even on the successful part completion of the work. It is the object of this article to show that extensions of credit from time to time on work that is progressing with financial success are justified.

The financial situation of the contractor is about as follows: On the tenth of each month he receives payment for 85 or 90 per cent of the work that he has completed to the satisfaction of the architect during the previous month. In the case of large buildings, where the architect keeps a close supervision on the work and where the amount involved is so great that a contractor must realize at once on his work, it is sometimes stipulated that payments shall be made not later than the fifth of the month following that in which the work was done. Such a favorable arrangement is the exception. More often the contractor finds his payment delayed beyond the agreed date, and this is especially true in the case of private work where owners are simply lax in their accounts. Taking the tenth of the month as the average date on which contractors are paid for their work, the whole account is carried for 25 days. During this time it is necessary for the contractor to devote a large part of his capital to meeting payrolls and to the payment of material bills to the exclusion of attempting other profitable work. It is especially at such time that contractors desire to obtain greater credit. Nor does this seem to be asking too much if it can be shown that the contractor has delivered, in the shape of building work already completed, a consignment of goods at a profit. In the various lines of manufacturing and distributing business the credit systems are so well standardized that such deliveries can be realized upon.

The average banker is not familiar with the details of the different kinds of business. His occupation is to loan money safely at a profit, and he naturally prefers to hold money rather than allow it to go for some unstable undertaking. From time to time he sees buildings undertaken at a loss by contractors, and knowing the many uncertainties of the building work, he tries to avoid advancing any more capital to contractors than he can see covered by tangible assets. But if he was convinced that a contractor had assets in the shape of completed work he might decide that a loan could be safely made upon that sort of an asset. The thing to do, therefore, is to provide some means by which a banker can be convinced that such work is really a safe asset. For a contractor to approach a banker for a loan with the detailed statement, based upon cost records, of certain work that had been completed at a profit, would scarcely result in convincing the banker that he should make that loan. This is because the banker is not familiar enough with contracting work to assume on his own initiative that such a statement covers the full expenditure that must be made on the so-called completed work, or that the

statement in itself is correct. Were he to make a loan it would be because of his faith in the contractor rather than from any deep-seated conviction of security brought about by examination of the statement Therefore, at present, the impersonal value of statements of costs is small in obtaining loans.

Now, to make statements of costs valuable in themselves, they must appeal impersonally to the banker or credit man, and the surest way to gain this impersonal value is to have the statements guaranteed by some reliable intermediary between the contractor and the lender. In certain lines of private banking there are houses that maintain a staff of competent technical men to pass upon the soundness of proposals for loans. Why would not some similar body be of advantage to general banking houses that make a practice of loaning to contractors?

In itself the establishment of a central board to which such banks could subscribe is not a difficult matter. This board should be composed of efficient engineers and estimators, well enough versed in the different kinds of construction methods to enable them to pass accurately on the correctness of contractors' estimates for bids, and on job costs. To further facilitate their work standard systems of estimating and cost-keeping could be established by this board. When a contractor has borrowed to the limit of his available capital, and has successfully completed work upon which he wishes to realize while awaiting for payment from the owner, let him present a cost statement of his completed work along with his estimate to the bank. The bank can then refer to this board for a verification of the statement. This board would examine the statement, check the actual work in place, and then report to the bank. Such a proceeding would enable the banker to get a clear and definite statement of the problem that he is dealing with.

The expenses of this board could be met by charging the contractor a stipulated examination fee, to be paid at the time the request was made. Such a charge would also tend to keep down the number of unsound requests, because no contractor would desire to pay a fee for the examination of a proposal that he felt was unsound and on which he could get no loan.

When the huge amount of money involved yearly in building work is considered, and it is remembered that the contractor is in a position where he is willing to pay the highest rates of interest to get ready capital, it seems that this proposal offers a field for loans of large amount at a profit much greater than is usual in the established lines of business.

INTERESTING CRUSHER INFORMATION.

This is the era of efficiency in the business world—efficiency in man and machinery. To compete successfully with their rivals in the fierce struggle for commercial supremacy, progressive engineers are turning as never before to the modern crushing machinery provided by modern inventive genius.

The Cement and Concrete Industries for an instance use a number of materials in order to make a more solid and compact product. The good-roads builders and contractors have taken a great interest in crushed materials. Many of the Clay-working and Pottery Plants make good use of materials that were thought worthless, by grinding them up and using the crushed materials.

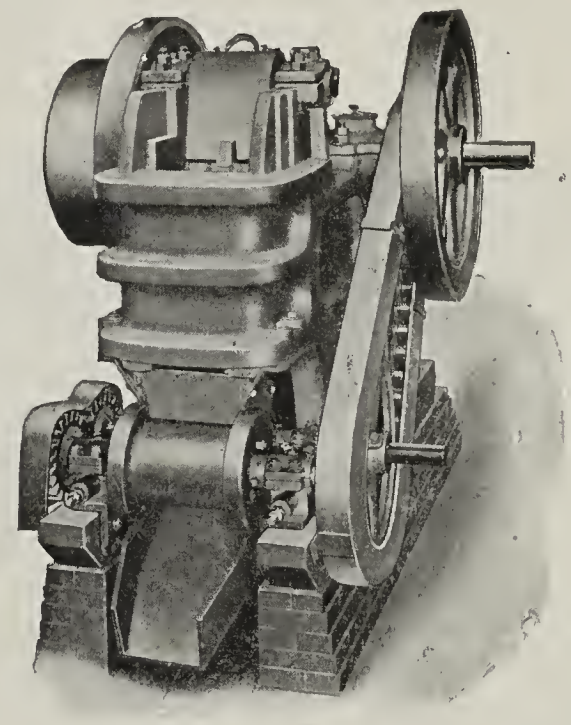
A modern crushing machine that will take in large pieces of stone and reduce it to a powder, or in fact any size desired, is indespensable on any plant where such a machine could be used.

At no previous time in its history, we are told, has the Henry Martin Brick Machines Mfg. Co. at Lancaster, Pa., enjoyed so prosperous a season in the sale of crushing machinery as the present one, which is an evidence of the popularity of their modern and up-to-date stone crushers and grinders, which are built in four different sizes.

Especially Suited for Concrete Industries, Etc.

These Modern Crushers are self-contained and a slow speed outfit, which does not grind itself to pieces. It needs no special foundation, it can be set up on any solid floor or earth, and is ready for the belt. It can be adjusted in a minute to crush to powder, or to sand, or to ballast.

These Crushers and Grinders are designed for great strength and durability. They are adjustable, so as to crush the stone from large pieces of rock down to the fineness of sand. It can be quickly regulated, and with out expense, so as not to crush to the fineness of sand but coarse, say to ½ or ¼ inch material; furthermore, it can be used for coarse crushing without the addition of the grinding parts, say to crush the stone down to 1½ inch and 2 inch material. Maximum capacity 50 tons daily.



The body of the crushers are cast in one solid piece, thereby doing away with bolted joints; the small parts are all well proportioned, the swing jaw or pitman being exceptionally heavy and strong, the jaw or toggle plates are very hard and made of a special mixture, chilled on the wearing surfaces semi-steel, and easily removed. The cylinder or grinder beneath the upper jaws are chilled, rigidly attached and adjustable with draw-bolts, built throughout in the best workmanlike manner.

The entire machine is driven with one belt, and is provided to also attach an elevator and also a screen if desired, so that they can be driven direct from the eccentric shaft of the crusher, using the one belt from the engine or motor to drive the complete outfit.

These crushers and grinders will produce concrete materials from waste and rubbish (*right on the job*), especially in the removal of old buildings. They will also produce fertilizing materials for farming use.

This is the most successful equipment, and one we guarantee to give entire satisfaction.

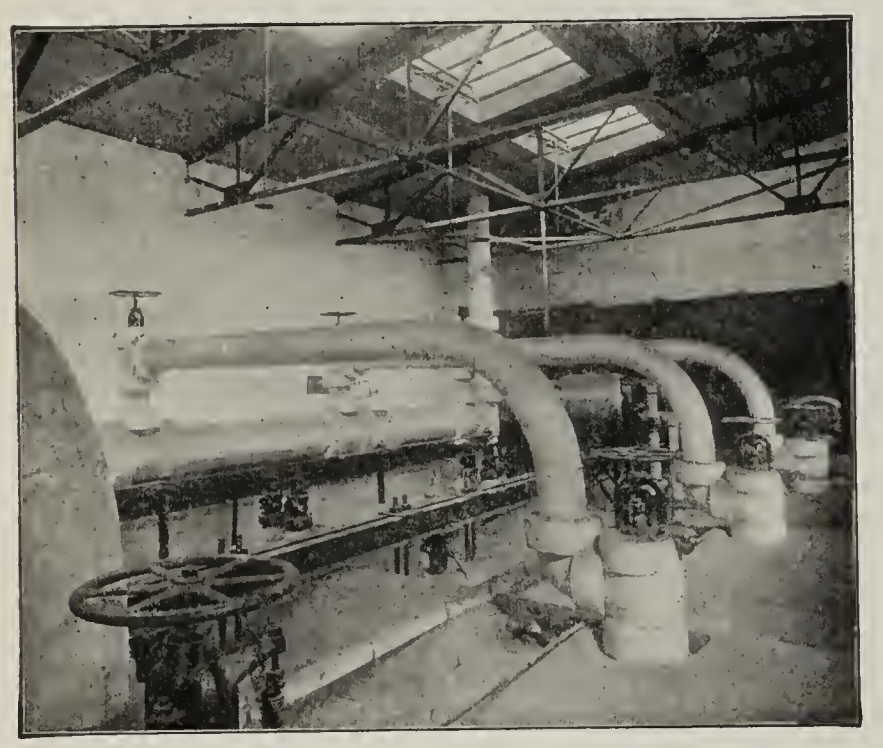
TAYLOR MESABA CHAINS.

The S. G. Taylor Chain Company, general offices 138 South Dearborn street, Chicago, manufacturers of the famous Taylor Mesaba chains for steam shovels has recently established a new modern up-to-date factory at Hammond, Ind., and are now in a better position than ever to turn out a high grade chain. The Taylor Company have built up a reputation for quick shipments, and our readers should avail themselves of the Taylor service as they make very prompt shipments.

An Improved Non-Return Safety Boiler Stop Valve

The great importance of NON-RETURN BOILER STOP VALVES for use on a battery of boilers is universally acknowledged, and in some countries their installation is compulsory. It is evident that should a tube be blown out or a fitting ruptured in one of the boilers of a battery, the steam from the other boilers would rush into the header and discharge into the disabled one. An ordinary stop valve would here be inadequate, as considerable time would necessarily be consumed in reaching and closing the valve, and a certain amount of danger must be anticipated. The Non-return Safety Boiler Stop valve shown herewith has been given very severe tests, and is in use in a large number of high pressure power plants, in all cases giving perfect satisfaction.

Fig. 1 shows this improved valve applied to a battery of boilers in the plant of The New York Rubber Company, Matteawan, N. Y. Fig. 2, a vertical section of the valve parallel to the pipe and Fig. 3, a section at right angles to the pipe.



No. 1.

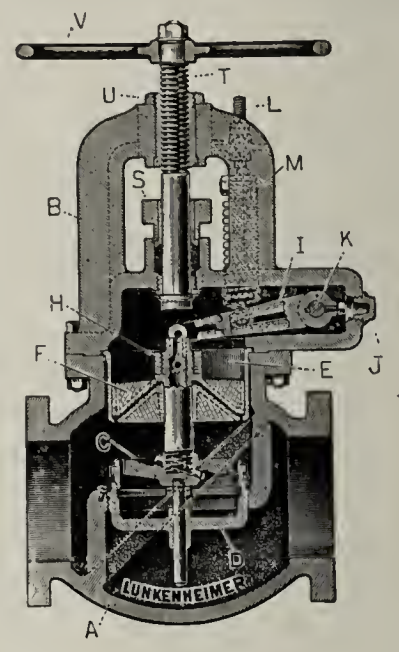
When these valves are used, should an accident occur, such as the blowing out of a tube in the boiler or any rupture of the headers, shells, etc., permitting the steam to escape, the valve attached to that boiler will immediately close.

This will prevent the escape of steam from the other boilers connected with it in battery, and the danger to life and property will be greatly lessened. The plant can be operated with the other boiler or boilers, without interference, thereby preventing the closing of same and the loss of time and money.

This valve will prevent steam from being turned into a boiler which has been cut out for cleaning or repairs, as it cannot be opened by hand when pressure is on the header side. It can, however, be closed when desired. The valve can be connected in either horizontal or vertical position.

A unique arrangement of outside spring and lever mechanism has been provided for the purpose of effecting a slight counter-balancing effect to hold the valve open, this being necessary in order to counteract the influences within the valve or line which tend to actuate the disc with every slight fluctuation of pressure.

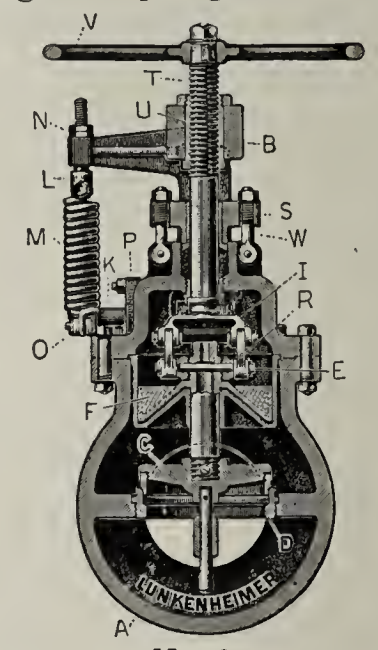
These fluctuations, usually caused by the engine, are frequently met within steam lines, and unless some means, such as are shown in this construction, are applied for counteracting these pulsations, the disc will be kept in continual motion, and with the lack of lubrication within the dash-pot, rapid wear will soon take place, causing a clearance between the piston and the dash-pot. As the amount of clearance increases,



No. 2.

the dash-pot becomes less effective and chattering soon results, causing great damage to the internal parts of the valve. Where the fluctuations of pressure do not exist, and the flow of steam is steady, the use of the exterior spring and lever mechanism is not necessary. Hence, the valves are regularly furnished without tension of the spring, and the dash-pot arrangement can here be depended upon to cushion the movement of the disc.

Should a pulsating condition develop, which can easily be detected by observing the movement of the spindle L, the regulating nuts N can be adjusted, gradually placing the spring under tension, until the



No. 3.

rapid movement of the spindle L is stopped. This adjustment of the nuts tends to lift the disc from off its seat as it places the spring under tension, causing it to pull upon the lever O. This lever is keyed to the shaft K, which shaft enters the valve through the stuffing-box P. Attached to the shaft O, is the forked arm I, to which are pivoted the links R, which in turn, are loosely connected to the piston F. When the spring is under tension, the disc is raised from its seat and cannot close until the steam pressure above the disc exceeds that under it. This difference in pressure which is governed by the tension of the spring, is never more than five pounds.

When the valve is properly set to overcome the tendency of pulsation, the disc remains practically in equilibrium until there is a reduction in pressure on the inlet side, when it will instantly close.

Attention is called to the large bearing surface of the piston within the dash-pot. All parts of the valve subjected to wear are renewable, and this includes the disc and seat ring, though the seating faces of the disc and seat ring can be reground a number of times before it is necessary to renew these parts. The stuffing box, through which the stem T travels, is of large size and entirely exposed to the cooling effects of the air. It can be packed under pressure when the stem is raised to its limit, as a shoulder on the bottom of the stem forms a seat against the bronze bushing in the bottom of the stuffing-box. The stem T operates in the bronze hub U in the top of the yoke and bronze bushings in the gland and stuffing-box, thereby preventing corrosion and insuring easy operation. These valves are made in five different combinations of materials in order to suit the requirements of various conditions of superheat and high pressure, and also to meet the specifications of engineers who may differ as to what is best suited to the purpose.

The Lunkenheimer Co., of Cincinnati, Ohio, are the manufacturers of these valves.

They have issued an attractive booklet, which they are willing to send to any one interested.

CEMENT DELIVERED IN BULK.

The Universal Portland Cement Co. has been making some shipments of Universal Portland cement in bulk. Recently a carload of Universal left their mill at Buffington, consigned to the Pennsylvania Coal & Supply Co., of Milwaukee. This is probably the first time that cement has ever been shipped without being packed in sacks or barrels. The experiment proved highly successful in every way.

The car arrived at its destination with absolutely no signs of loss or damage. The cement was left smooth and undisturbed in apparently the same condition as when it left the mill. The car was unloaded with shovels into wheelbarrows and the operation seemed to cause less dust than does the handling of cement in sacks. Some of it was wheeled directly to the mixing plant of the Pennsylvania Coal & Supply Co's., block and sewer pipe factory and the rest of the cement was stored in a bin in one of the ware houses.

The Universal Portland Cement Co., is trying to find out whether the cement companies are wasting a great deal of time, energy and money in the handling of cement sacks. Dealers and cement users who have to team will probably continue to demand shipments in sacks. But factories making cement products and contractors doing big jobs adjacent to railroad tracks and using central mixing plants could probably be served better and more economically with bulk shipments of cement. The experiments may show that a large amount of capital is unnecessarily tied up in sacks and if it is found that cement can make a trip from the mill to the job in bulk just as well as in sacks, a heavy item of expense will be eliminated.

Portland cement is now one of the cheapest manufactured commodities on the market. A great many cement users and manufacturers as well would undoubtedly be happy if it were proven that putting 70 cents or 80 cents worth of cement into a 40 cent package could be dispensed with. Grain and other commodities having a much higher value per ton are shipped in box cars in bulk. It is believed that with a very small investment in unloading equipment and storage facilities, those who receive shipments of cement will find it a paying proposition to receive carloads in bulk.

ENERGY PLUS.

There are many reputable firms having a steady volume of business, and manufacturing their product with proper regard for quality so that their customers are loyal friends as well, and yet lacking in one some one thing that prevents their ever rising above the mediocre. On the other hand, here and there we find a manufacturing firm that stands head and shoulders above its competitors, and year by year advances steadily and consistently, enlarging its plant, increasing the force, and adding to the surplus.

The reason does not lie with the product manufactured, or in environment or chance. It gets down to the personel of the firm—the human factor. We find the real reason to be the same as that which causes one man, starting in life on an equal plane with his brother, to outdistance him in attaining success. It is something inherent in the man himself that we cannot quite explain, but which we call energy plus.

An ideal example of a manufacturing firm having energy plus is the Chicago Belting Company. Aggressive and progressive, growing, and ever increasing its output, it merits more than passing attention.

We have many times before in these pages given items of interest regarding its energetic activity, and now, when ordinarily business houses are keeping a watchful eye on the political arena, and we use the word this time purposely, we find this company reaching out, and like the late Alexander, seeking other worlds to conquer.

Within the past few months the Chicago Belting Company of Michigan, a subsidiary of the Chicago Belting Company, has been incorporated for the purpose of doing a general tannery business. Mr. A. C. Krueger is superintendent, and nowhere is there a man more capable of taking charge of this particular work. His whole business life has been spent in tannery work, particularly the preparation of rawhide, in which line he is known from coast to coast as an expert. This tannery, located at Niles, Michigan, is destined to make the name of the Chicago Belting Company even more universally known than it is to-day.

Another important move of the Chicago corporation, is the opening on July 1st of a branch store in Los Angeles, under the management of Leland Bros., men known for years as capable and successful belt salesmen.

With the opening of their Los Angeles Branch, the Chicago Belting Company have the whole United States covered, their other branches being located at New York, Ralph I. Poucher, Manager; New Orleans, Robert Carpenter, Manager; and Portland, Ore., J. W. McKenzie, Manager.

We shall watch with interest the future of this Company. Organized some twenty-one years ago, it has grown from a small belt shop with four presses to one of the largest belting manufacturers, and has a future full of possibilities for greater success.

A BIG JUDSON R. R. P. BLAST AT PIEDRA, CAL.

Early in May of this year a large blast was made for the Sharp & Fellows Contracting Company at Piedra, California, by A. H. Crane and H. F. Smith, representatives of the E. I. du Pont de Nemours Powder Company, of Wilmington, Delaware. All the rock which is used for ballast, concrete rock and building purposes generally, is handled by a steam shovel, and

Floor of Quarry at Piedra, Cal., Previous to Blast.

to facilitate handling, it was decided that the maximum quantity of rock be broken in sizes that could be handled without subsequent bulldozing or mudcapping. Photograph No. 1, taken before the blast, shows the quarry floor, which was 100 feet wide at this point, and 1,200 feet long. This photograph also shows, by the light waste dumps, the location of the tunnels which were driven to properly contain the various charges of explosives.

Blast at Piedra, Cal., Taken at Moment of Detonation.

The results shown by Photographs 3 and 4 indicate how accurately these charges were estimated and placed. They also show the large proportion of fine rock—85 to 90 per cent—and practically all of the broken rock remaining on the quarry floor, only one rock of any size being thrown over the edge. Photograph 2, taken just as the blast went off, shows the lifting effect of the Judson Powder.

These tunnels, shown in the plan view, were driven level with the quarry floor and at right angles to the face. Four cross cuts, two in each direction and parallel to the face, were driven from each tunnel to contain the explosive charge. At the end of each cross cut a sump or pit about 6 feet deep was excavated. This was done to give maximum amount of breakage and reduce to a minimum projecting pinnacles of rock to the quarry floor, which would delay the steam shovel while they were being blasted out.

The overburden at the breast of each tunnel was:

No. 1	70 feet
No. 2	85 feet
No. 3	93 feet
No. 4	98 feet
No. 5	104 feet
No. 6	100 feet

or an average overburden of 91 feet over the back powder charges, and an average overburden of 68 feet for the entire area.

The charge estimated to produce a maximum amount of fine material, and at the same time waste no material into the King's River, was 114,000 pounds

Quarry at Piedra, Cal., Showing Effects of Blast.

of Judson R. R. P. and 11,400 pounds of Hercules 60 per cent Nitroglycerin Dynamite, a total of 125,400 pounds of explosives. This charge was distributed in the cross cuts as follows:

Location.	Pounds Hercules 60 per cent N. G.	Pounds Judson R. R. P.	Location.	Pounds Hercules 60 per cent N. G.	Pounds Judson R. R. P.	Location.	Pounds Hercules 60 per cent N. G.	Pounds Judson R. R. P.
A	600	6,000	I	700	7,000	Q	700	7,000
B	650	6,500	J	700	7,000	R	700	7,000
C	250	2,500	K	250	2,500	S	250	2,500
D	250	2,500	L	250	2,500	T	250	2,500
E	700	7,000	M	700	7,000	U	700	7,000
F	700	7,000	N	700	7,000	V	800	8,000
G	250	2,500	O	250	2,500	W	250	2,500
H	250	2,500	P	250	2,500	X	300	3,000

Tunnel No. 1 had the least overburden and it was undesirable to obtain very much overbreak to the left, because a quantity of rock at this side was too hard

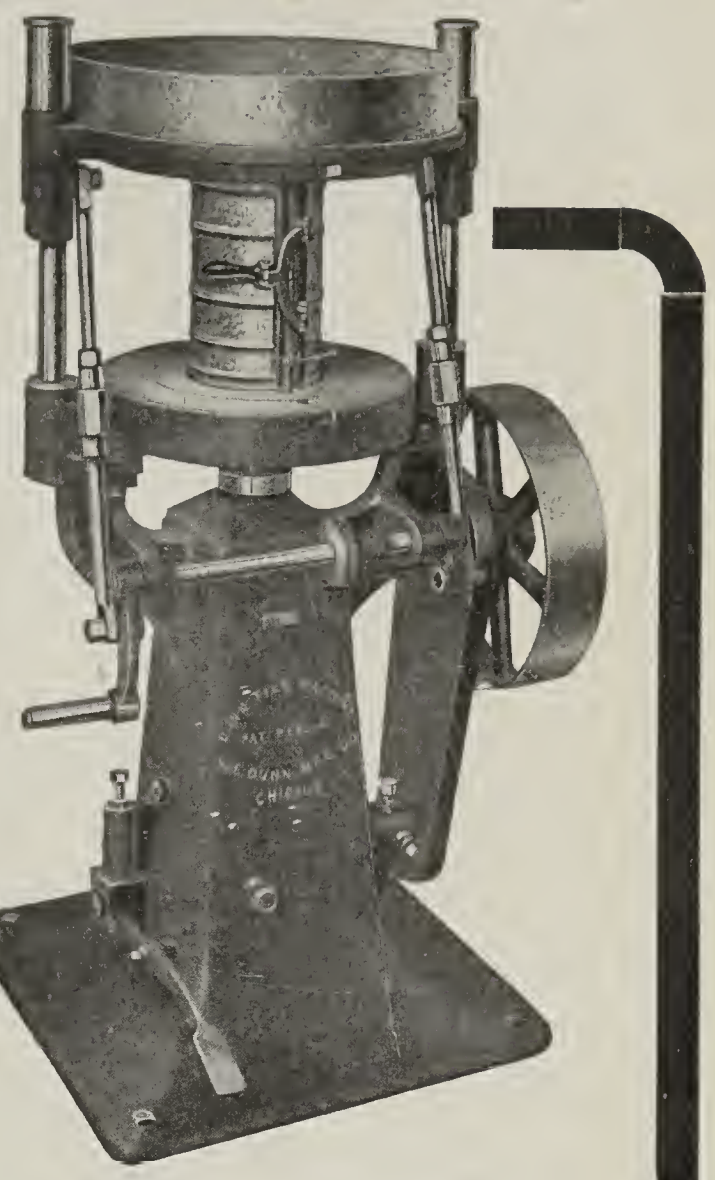
Let this Machine Make the Sale

By the Quality and Quantity of Drain

Tile it will turn out right in *your own plant*

We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.



Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

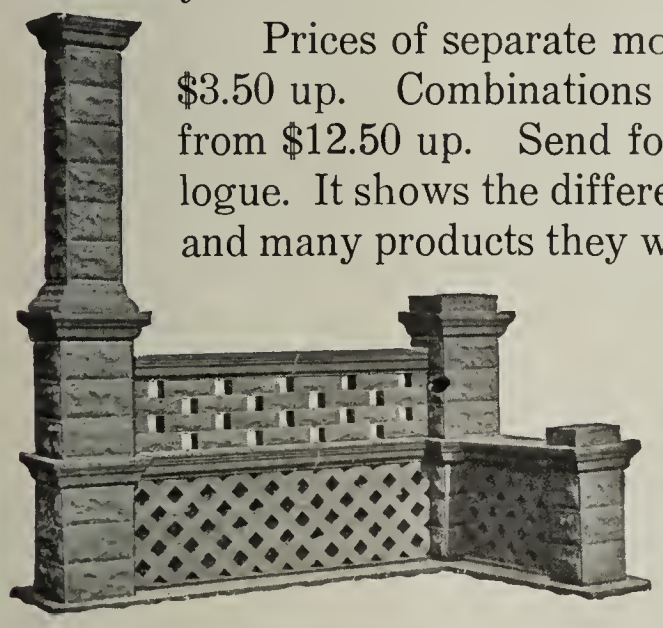
The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.

PRICE, $175

Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.



Prices of separate molds from $3.50 up. Combinations of molds from $12.50 up. Send for a catalogue. It shows the different molds and many products they will make.

Poured Sewer Pipe Molds

No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

W. E. DUNN MFG. CO.

4139 Fillmore Street
CHICAGO

for the crusher to handle, and it was desired to leave this rock in place to be blasted out later and wasted on the dump. The blast swept round this hard rock leaving it practically undisturbed. Tunnel No. 6 had a heavy overburden and maximum overbreak was desired, so the two Cross Cuts driven to the right from this tunnel were made five feet longer and they were loaded heavier than the others.

The Hercules Dynamite was not removed from the cases, but all Judson R. R. P. was removed and taken into the tunnel in the original bags, 200 pounds at a time. This was stowed snugly in the pits at the ends of the Cross Cuts, being tamped down by tramping on the charge, and loading progressed.

Tunnels Nos. 2, 3 and 4 were wet, considerable water dripping from the walls. All the pits in these tunnels were filled to a depth of 18 inches, large rock and the chamber was entirely lined with many thicknesses of paraffin paper from the Judson R. R. P cases to keep the powder dry. It was calculated by actual observation and measurement that the water seepage would about fill the interstices between the large rocks in the bottom of these pits shortly after the loading and tamping was completed.

One Victor No. 6 Electric Fuse was used in each charge, all being connected in simple series of 24. The connecting wire in each tunnel was trailed along at the junction of the floor and wall and covered with several inches of fine muck for protection while loading and tamping. All Cross Cuts were entirely filled, as well as the tunnels, to within 10 feet of the portals with much from the tunnel floors. This material was well stowed away from the top of the tunnels to eliminate air space, as much as possible.

All wiring was tested every two hours with a Galvanometer during the entire time of loading and tamping, which took seven days, working day and night.

A No. 4 Pull-Up Blasting Machine was used to furnish electric current to detonate the fuses. This battery was first tested with a Rheostat showing a capacity of 55 fuses, so there was plenty of excess current available.

The total breakage was estimated to be at least 350,000 cubic yards, at a cost for explosives of not over 2.6c per cubic yard, even though this shot was heavily loaded in order to get as fine breakage as possible. This heavy loading saved a good proportion of the added cost of mudcapping and result in delay to steam shovel work.

KENNICOTT WATER SOFTENERS.

The Kennicott Method of Softening Water consists of automatically treating varying quantities of water with proportionately varying quantities of materials in an automatic apparatus which purifies and softens the water at the lowest possible cost.

The Kennicott Water Softener, as this apparatus is called, is continuous in its action, automatically starting and stopping with the beginning and ceasing of the flow of water into the machine. The water is pumped but once into the Softener, and it is delivered at the top. The water as it flows into the Softener furnishes all the power the apparatus requires, both for mixing the chemical re-agents with the water to be purified, as well as for operating automatically all the mechanism of the apparatus says The Kennicott Co., Corn Exchange Building, Chicago.

After the impurities in the water to be treated have been precipitated from the water by the chemical re-agents, they are automatically removed from the water as it passes through the apparatus, and the purified water overflows by gravity from the top of Softener into the storage tank, without the necessity of re-pumping.

The machine starts and stops automatically, according to the supply of hard water. The amount of water taken in is regulated entirely, up to the maximum capacity, by the amount of water drawn out.

Kennicott's Laboratories—The Kennicott Laboratories are equipped and maintained solely for the analysis of waters. From six to ten expert chemists are constantly employed in making careful scientific analysis of waters. Our library of data covering water conditions in various sections of the country is perhaps one of the most complete in existence. We have made as high as 398 analyses of water from different sections of the country in a single month. Every result obtained is checked and re-checked so thoroughly that the possibility of error is practically eliminated. Our findings are accurate and absolutely reliable.

We lay particular stress upon this point because a correct analysis is the all-important first factor in the solution of any hard water problem, and because we have spent a small fortune perfecting our laboratory work. The skill, care and thoroughness exercised in our water analysis are but seldom considered necessary in commercial laboratories.

We publish a full description of the operation of our type "K" Softener which gives detailed information and many references from large concerns who are using this system. This covers almost every line of business, and the matter referred to will be mailed you upon request by mentioning Cement and Engineering News.

Our machines are guaranteed to produce uniform results—and we make good.

NEW BOOK ON ROCK DRILLING.

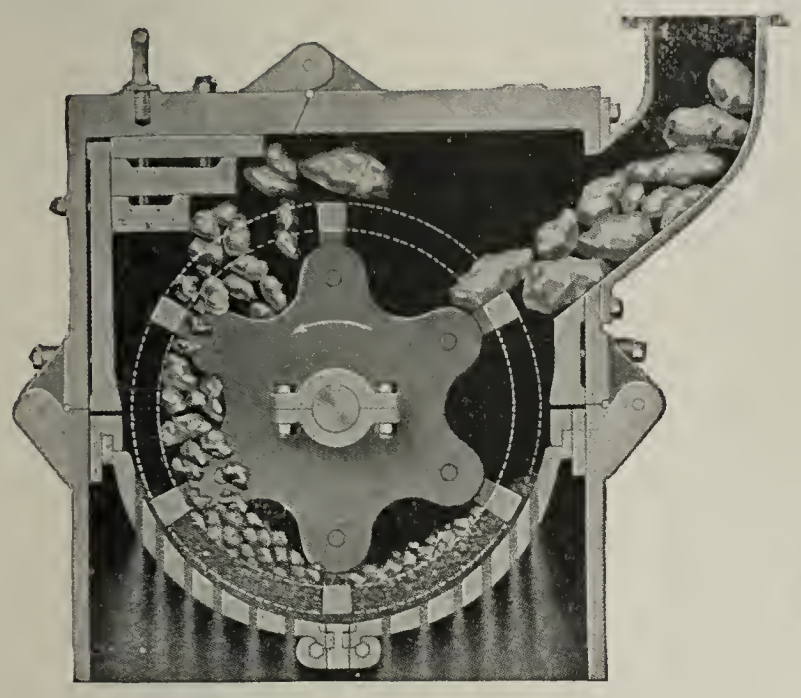
Rock Drilling. By R. T. Dana and W. L. Saunders. Pp. 319; ill., index. John Wiley & Sons, New York, 1911. For sale by the Cement & Engineering News, 1117 Schiller Bldg., Chicago. Price $4 .

Following a general introductory statement covering blasting and explosives, this volume treats in detail the methods and costs of open-cut excavation and submarine rock-drilling. It is based principally on material collected and compiled by engineers of the Construction Service Co., and includes accurate records of cost and drill duty in many kinds of work. Diagrams and tables are freely used in such shape as to make more than a mere record of cost. Accurate comparisons and analyses become easy. The book is well written and well illustrated and is sure to prove of large value to consulting and constructing engineers.

FREE BOOKS ON CONCRETE.

The Northwestern Steel & Iron Works, 1080 Spring street, Eau Claire, Wis., the largest manufacturers in the United States of concrete mixers, both continuous and batch; ornamental column and baluster molds, drain and sewer pipe molds, brick machines, etc., have just issued a very useful and interesting book which they are sending free of charge to readers of Cement & Engineering News. It tells you how you can save 15 to 50 per cent on your concrete purchases. Write for a copy at once.

THE GARDNER CRUSHER
Disintegrator and Pulverizer



OUR NEW MODEL

Low Motive Power **Strong Construction**
Any Desired Fineness **Moderate Prices**

The best machine on the market for reducing material from 3-in. to 20 mesh and under in one operation.

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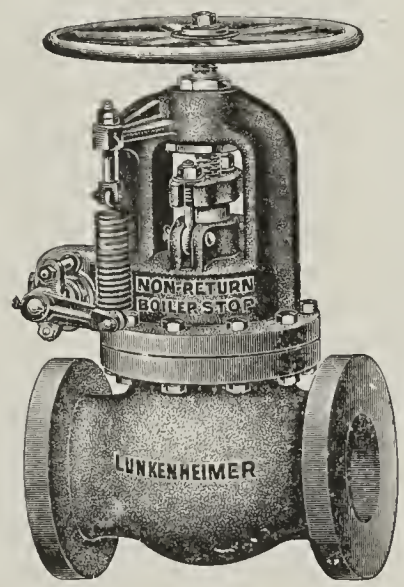

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CEMENT DRAIN TILE IN IOWA.

The state of Iowa is taking the lead of every other state in the extent of the work of being done in land drainage. It was shown last year at the convention of the Iowa State Drainage Association that up to 1910 in seventeen counties northwesterly from Des Moines the value of the county or public drainage work exceeded at that time the sum of $9,200,000, that in fourteen other counties more than $6,000,000 worth had been completed, and it was estimated that the private work in these thirty-one counties came to the value of $60,000,000. The future work to be done will require an expenditure of $300,000,000, and in the remaining counties of the state fully half of this amount must be done so that the cost of drainage in Iowa will come to the stupendous sum of $450,000,000. If the state were engaged in digging a Panama Canal within her borders the undertaking would attract more attention and the expenditure would stamp this undertaking as one of the first magnitude in the history of the development of our country.

In the inaugural address of the governor two years ago we were told that 125,000 miles of drain tile had been laid in this state. Since that time more than 50,000 miles have been added and they are going into drainage work at the rate of 30,000 miles or more each year. Up to 1910 the cost of the tile laid in the ground—tile and trenching alone—was $105,000,000 said the president of the Iowa State Drainage Association, and it was stated that $150,000,000 more will be required to complete the work. Today we may say that from twenty to twenty-five million dollars worth of tile and tile ditch is being done annually, about half being for tile and half for the trenching.

Most of the tile drainage in Iowa is confined within a V-shaped area with Des Moines at the point and the base on the northern boundary line of the state. The surface of this area was originally half high land and half swamp, being generally level or slightly rolling, except along the rivers where it is rougher. The soil is black loam underlaid with yellow clay mixed with some gravel and sand. The low lands were rich with decayed vegetation and generally speaking could be cultivated in dry seasons. Men from the east saw the possibilities when the swamps were drained and their purchases forced the prices of land higher and higher until it became a business necessity to get rid of the ponds and sloughs and to make the land suitable for cultivation acre for acre, year after year, independent of the rainfall. When completely drained this area of northwestern Iowa will be a garden spot noted for its large and certain crops.

NEW CEMENT PLANT AT TREMP, SPAIN.

Mr. Melville M. Smith, the well known chemist and engineer, and one of our oldest subscribers, writes that he has accepted the position of Chief Chemist of the Ebro Irrigation and Power Company's cement plant, which is to be built at Tremp, Province of Larida, Spain. The plant is to be a 2-rotary, 9x140 proposition, the product from which is to be used by the Ebro Company in the construction of dams, canals, etc., in the vicinity of Tremp. The plant is to be dry process, limestone and silicious dry marl being the crude materials.

REINFORCED CONCRETE DESIGN.

Reinforced Concrete Design is the subject of a new book by O. Faber and P. G. Bowie just received from the printer. Price, $3.50. Sent postpaid by Cement and Engineering News upon receipt of money order.

PORTLAND CEMENT FAMINE IN CANADA.

In view of the criticism of the action of the government in suspending the duty on cement, an authoritative statement has been issued from Ottawa which sets forth the principle that while the government will uphold the protection of home industries, a great national emergency such as has arisen in the cement trade must govern. It is held that Canadian manufacturers are still amply protected. The statement in detail is as follows:

"The remission of fifty per cent. on duty on cement is a temporary measure to meet the cement shortage in eastern and western Canada, and is not in any way in conflict with the established policy of protection to Canadian industries.

"The duty upon cement under the existing tariff amounts to about 52 cents per barrel. Cement sells freely in the United States at 70 cents per barrel, and less. Therefore, the duty amounted to a protection of about 75 per cent. to Canadian cement manufacturers. Cutting this in two for a period of four months leaves a duty of over 35 per cent., which is 10 per cent. higher than the average duty upon all dutiable goods entering Canada.

"In addition to the above, the through freight rates to points in the western peninsula of Ontario have been twice raised since last year, once in March and again in May, the total increase being equivalent to 22 cents per barrel. Taking this into consideration, the remission is about equalized so far as Ontario is concerned. Few, if any, industries in Canada possess such a degree of protection as cement, which is an article in universal use among farmers, builders and manufacturers. The cement manufacturer of Ontario today enjoys the following protection as against his American competitor:

"(1) Freight rate, 60 cents per barrel.

"(2) Duty rate, 26 cents per barrel, total 86 cents.

"Deducting his own freight rate of say 25 to 30 cents to Toronto or other market, he is left a margin of from 50 to 70 cents a barrel on a commodity that sells freely in the United States for 70 cents.

"The situation which gave rise to the action of the government was critical and threatening the complete tie-up of public works in the Maritime Provinces, cessation of building and paving in the western cities. with consequent interruption of employment of thousands of men. Four-fifths of the cement used in Canada is manufactured by the Canada Cement Company, which has alleged lack of lake and rail transportation to western and eastern markets. The smaller cement manufacturers of Ontario did not ship to the west or east and therefore are not in a position to afford relief.

"The government stands for adequate protection to native industries, but natural consideration must govern in an emergency such as arose in the cement case. To give an idea of the cost of cement in Canada, it may be observed that the price recently at Fort William was $1.25 per barrel, at Winnipeg $1.95, at Saskatoon $2.50, at Edmonton over $3.00, and at Calgary $2.60. These prices are determined by adding freight rates to the Fort William price. Such freight rates are one cent a ton per mile, or 26 cents per hundred pounds, for a haul of 400 miles from Fort William to Winnipeg.

"As a result of the action of the government, the Canada Cement Company is ordering four new vessels to take care of their western shipments, and contemplating the erection of plants in the northwest. The railways have also given large orders for rolling stock and are straining every effort to overcome the congestion at the several points of shipment."

CEMENT
... AND ...
ENGINEERING NEWS

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CEMENT AND ENGINEERING NEWS

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Advertising copy or changes in ads. must be in this office by the 25th of each month, as hereafter our magazine will appear on the 5th of the following month.

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CHICAGO, SEPTEMBER, 1912

CEMENT SHOWS.

Pittsburgh and Chicago will have the big cement shows for the next season; New York and Kansas City will be omitted. Announcements to this effect have been issued by the Cement Products Exhibition Co., 72 West Adams street, Chicago. The date set for the First Pittsburgh Cement Show is December 12-18, 1912; the show will be held in Exposition Hall, Duquesne Way, Pittsburgh. The annual Chicago exposition will be held as before in the Coliseum. The date for the Chicago show has been set for January 16-23, 1913.

With the information as to the Cement Shows comes also the announcement by President Richard L. Humphrey of the National Association of Cement Users that the Ninth Annual Convention of this association will be held in Pittsburgh in December in connection with the show. The selection of Pittsburgh for a show and the abandonment of New York was based upon the desire of the management to hold a show in a new territory. Exposition Hall, Pittsburgh, has even more floor space than the big Coliseum in Chicago. The conditions for installing and removing exhibits are ideal. The building is conveniently located with reference to the principal hotels and central business district of Pittsburgh. The dates for the two shows this time have been fixed earlier in the winter. This action was taken after a careful study of the advantages offered by the various months and after consulting the opinion of a great many exhibitors.

A great many inquiries for space at the Pittsburgh and Chicago Shows have already been received by the Cement Products Exhibition Co. The space rates for the shows next season have been put upon a very reasonable basis. That the cost of space has not been too high in the past is evidenced by the annual report of the Exhibition Co., which shows that there was only a surplus of $900.00 remaining at the close of business last winter. While the total income and expenses exceeded $75,000.00, the balance of only $900.00 indicates very conservative management. The policy originally adopted by the Exhibition Co., of spending all the revenue for the benefit of the shows, has been rigidly adhered to and has been adopted as the policy of all future shows. All indications point to the continued success of the Cement Shows. A number of innovations in the Cement Show arrangement, equipment and decorations are promised. The personnel of the management remains the same. J. P. Beck is General Manager. F. E. Guy, Traffic Manager, will again assist exhibitors in their transportation problems, and M. E. Gordon has again been selected as Installation Manager. The coming shows will be advertised more widely and vigorously than ever. They will be of their usual scope, embracing all articles and appliances concerned with the use of concrete.

GRAVEL COMPANY FILES COMPLAINT.

C. F. Hunt, president of the Lafayette Gravel and Concrete Company, yesterday filed a complaint with the Indiana railroad commission at Indianapolis against the Lake Erie and Western and twelve other roads operating in Indiana. Two of these roads are west and ten are east of Lafayette and all connect with or intersect the Lake Erie. The complaint is in two paragraphs.

The first paragraph asks that the Lake Erie be required to absorb the switching charge of $3 a car made by the Monon railroad for delivering cars of gravel and other products of the company to the Lake Erie at the Lafayette junction.

The second paragraph asks that the Lake Erie and connecting roads establish a reasonable joint rate for all towns on their lines within a distance of 150 miles from the Lafayette junction.

EXHIBITS AT STATE FAIRS.

Over 150 dealers in building materials handling Universal Portland Cement made exhibits in 1911 at County Fairs at which prizes of Universal Portland Cement were given away in contests. The same policy is to be further extended this year, the company offering not only prizes for a contest but complete materials for an attractive booth, among them being a concrete stock trough of one-fifth actual size, to show the water-tightness of concrete; a huge Universal sack, six feet high and colored posters which will show the methods of concrete farm construction. The Universal Portland Cement Co. will be represented at many hundred County Fairs this year.

CONCRETE AGGREGATES.

Complete knowledge of all cement aggregates is necessary before we entirely master the science of concrete engineering.

Washed sand and gravel have done much for safe concrete construction, but engineers should come to a better understanding of what constitutes safe aggregate and a standard test should be adopted to be included in all specifications.

The National Association of Cement Users is now investigating this problem through its Committee on Specifications and Methods of Tests for Concrete Material. This committee desires to secure samples of sand apparently clean but found unfit in practice. Also all field and laboratory data and specifications is desired. Address Cloyd M. Chapman, care Westinghouse Church, Kerr & Co., 10 Bridge street, New York.

Autoclave Boiling Test for Cement

A new requirement or specification which all cement used by the Delaware, Lackawanna & Western must pass is as follows:

Portland cement used shall pass 78.per cent through a 200-mesh sieve instead of 75 per cent, as demanded by standard specifications of American Society of Testing Materials. Cement shall remain sound after being subjected to boiling under pressure of 20 atmospheres for a period of 2 hours in an autoclave, a metallic vessel, gas tight when closed, used for heating liquids under pressure.

The reason for this seemingly rigid or radical requirement was the result of an investigation by H. J. Force, chemist and engineer of tests, into the causes of disintegration of numerous concrete structures along the lines of the Lackawanna, after which it was concluded that there was still room for improvement in Portland cement, though the great majority of manufacturers and users are satisfied to manufacture and use it without trying to have or insisting on having better cement. The failures examined were classified under three heads, viz.:

1. Those due to poor sand and stone and poor mixing.
2. Those due to freezing of concrete before final set; the use of calcium chloride, and hot weather concreting where initial set is acquired before placing.
3. Those due to green, unseasoned, and improperly manufactured material.

Although a great number of the failures were due to the first two mentioned causes, many of them, where the materials and workmanship were known to be of the very best obtainable, could only be laid to some unknown fault in the cement. In these days when such enormous amounts of cement are used, about the only tests besides tensile tests, which the user has time to make, are the accelerated tests; naturally, therefore, the boiling test was made the main point of the investigation. A laboratory was established and the autoclave test was the outcome of the investigation.

The failure to pass the ordinary boiling and the autoclave test is, according to the investigators, due not to the free lime or magnesia content in the cement, but to a certain kind of coarse granules which fail to pass the 100-mesh sieve and a part of the material failing to pass the 200-mesh sieve. A briquette made of cement containing these granules, probably a hard-burned clinker, when tested in the autoclave, swells, disrupts and absorbs moisture, due to the breaking up of these coarse granules. The action being the same, but very much more rapid, as that which takes place in structures where cement containing comparatively coarse granules absorbs enough moisture, after a period of a year or two, to disrupt the granules and cause the incipient failure of the structure.

An interesting feature disclosed by the tests was that cement briquettes passing the autoclave test show a decided increase in tensile strength after the test. This test being in a way one of constancy of volume, it is to be expected that no decrease, but rather an increase in tensile strength would take place in cement passing the test.

That the requirement is not very hard to fulfill by the manufacturer is shown by the tables of tests of materials from different mills. In one case the tests of the first two lots from a certain mill went to pieces when tested; a complaint was entered and every succeeding lot passed the test very successfully, a notable fact being the fineness of the cement, an average of about 80 per cent passing the 200-mesh sieve.

All the finely ground cements, however, did not pass the tests, showing that something besides coarse granules causes failure when put to the autoclave test. In most of such cases the failure was traced to poorly manufactured and unseasoned clinker.

It is now universally granted that the fine material in cement is the part that enters into the reaction when setting takes place. Therefore, any coarse material which is not broken up and does not acquire the proper amount of moisture in mixing, only weakens the concrete, renders it less constant in volume and subjects it to slow disintegration with age due to absorption of moisture.

Although it appears from these tests that better cement can be obtained very readily by finer grinding, we do not believe that other factors, such as mixing the materials in manufacture, burning of clinker and seasoning of clinker before grinding, should be overlooked. It is a fact that cement clinker, if stored for a considerable time before grinding, does not tend to disrupt so easily when subjected to the accelerated tests. In this age, when everything is sacrificed for speed, it is not surprising that cements are not what they could or ought to be. The manufacturer, true to the spirit of the times, will speed up the output of his plant, if the occasion demands, and in all cases the ultimate consumer "pays the fiddler." Several manufacturers have very wisely installed the autoclave tests at their plants, which goes to show that it has possibilities; others, however, of the "stand-pat" type consider it only a seasonable fad which will soon be dropped.

Concrete has been called a permanent material, and it is, within certain limitations, when all materials entering into it are of a lasting quality. We cannot hope, however, to make a lasting material of any combination of substances when the principal ingredient is not durable, which is true of neat cement at the present time.

The autoclave test, although it may seem very rigid and severe, because of the ability to detect thereby unseasoned, poorly ground and slow hydrating cement, we believe is a step toward the ultimate goal of the cement industry, cement with lasting qualities.

CONCRETE WITHOUT MOLDS.

"Ornamental Concrete Without Molds," by A. A. Houghton, is the title of a new book just placed on the market. It is explanatory of a system of molding ornamental concrete units with templates; contains additional information on the proper preparation of concrete for ornamental work, and proportionate size of the various units and the reinforcement of work; contains everything that a concrete worker needs to know to perfect the many styles of ornamental concrete work without the purchase of molds, and is intended for the concrete worker and contractor of small means or who cannot afford to purchase molds for the many various styles of work he is called upon to do, as well as for the artistic workman who wants a surface that is perfect.

Copies of the book may be secured from Cement & Engineering News, Schiller Bldg., Chicago, on receipt of price, $2.00.

NEW SUPERINTENDENT FOR PHOENIX.

Edward H. Tait, of Easton, Pa., who recently resigned as assistant superintendent of the Vulcanite Portland Cement Company's plant, has been appointed superintendent of the plant of the Phoenix Cement Company at Nazareth, Pa.

Testing Sand for Use in Concrete and Cement Mortar

By Cloyd M. Chapman, M. AM. Sec. M. E.

In the cement testing laboratory of Westinghouse, Church, Kerr & Company it has long been the custom to examine carefully sand which was to be used in making concrete or cement mortar whenever there was any doubt as to its suitability for the purpose for which it was designed. Experience has shown that it is more important to test sands of unknown or untried quality than is generally supposed. Many failures to make good, hard, quick setting concrete have been charged up to the cement which were entirely the fault of the sand.

As no standard set of tests for sand have as yet been adopted in this country, each laboratory now testing sands uses its own method. The method outlined below has been in use in the Westinghouse, Church, Kerr & Company laboratory for sands of all kinds, and it may be of interest to others who use sand for concrete and mortar.

Taking Sample in Field.

Air tight one gallon tin cans having tight fitting cover or cork are provided for shipping samples from the field to the laboratory. A wood covered tin can makes a very satisfactory container, which can usually be used over and over again. Samples of sand should never be sent in cigar boxes or other wood containers.

Samples are taken from the shipments of sand as they arrive on the job. A preliminary inspection is made of the lot, whether wagon loads, car loads, barge loads, or other sort of shipment, to ascertain whether the sand appears to be all of a uniform quality and size. If the various units of the shipment seem to vary, a separate sample shall be taken of each unit and the units shall be kept separate until the sample has been examined and reported upon by the laboratory. For instance, if two carloads of sand are received, one of which is evidently finer than the other, then a separate sample shall be taken of each car, and if it is necessary to unload the cars at once they shall not be unloaded onto the same pile, but shall be kept separate, provided there is any doubt in the inspector's mind as to the suitability of either sand. The samples shall be taken if possible during the unloading, when the shipment is in cars or barges, or from the pile after the wagon has dumped when the sand is received in wagons.

When it is practicable to keep an inspector at the sand bank at all times when shipments are being loaded, so that it may be positively certain that the sand which is sampled is the sand which is shipped, then samples may be taken at the bank before loading. Or, if sand is obtained from a source which is known to produce no poor sand, has no spots or streaks of poor sand, has no over-burden of loam or other objectionable material which might become mixed with the sand before it is shipped, and is in all reports a deposit from which a uniform grade of sand may be depended upon, then the samples may be taken at the bank without the maintenance of an inspector at the bank.

In sampling a bank of sand which has exposed vertical faces, a small vertical channel of uniform size is scooped out of the face from bottom to top. The sand scooped from this vertical channel, if more than enough to fill the container, is thoroughly mixed up and reduced by quartering to the quantity desired.

A tin dipper or baking powder can makes a suitable tool with which to cut the small channel or groove up the face of the bank. By cutting such a groove or channel at each of the faces in the bank from which sand is obtained, samples are secured which represent with a fair degree of accuracy the sand in the bank. The samples taken from the various faces are not to be mixed together, but are marked for identification as to location and sent separately to the laboratory for examination.

If the bank contains both good and poor sand, and it is necessary to maintain an inspector at the bank to insure the shipment of good sand and to sample the sand to be shipped, then the samples may be taken from the piles of sand being loaded. Such samples are taken with a small tin box such as a pepper or spice box, holding ½ pint or less. With this small receptacle portions of sand are scooped up from many parts of the sand pile, filling the receptacle each time and emptying it into the larger can in which it is to be sent to the laboratory. The number of samples to be sent to the laboratory is very largely a matter of judgment on the part of the inspector. Whenever there is any doubt as to the quality of any shipment of sand, a separate sample should be taken of it.

In sampling sand after the arrival on the job, the same general rules are to be followed. Use a small receptacle such as a glass tumbler or tin box holding not more than ½ pint, and fill it from as many parts of the pile of sand as is necessary to fill the can which is to be sent to the laboratory. Dig into the pile; do not take what rolls down the outside, as this may be composed largely of the coarser grains or pebbles.

To the can containing the sample attach securely a shipping tag giving the name or number of the job from which the sample is shipped, the name of the dealer furnishing the sand, the quantity of sand in the shipment represented by the sample, the exact location of the bank or deposit from which the sand was shipped, and the signature of the inspector who took the sample.

The sample is then shipped by express to the laboratory for examination. At the same time that the sample is shipped, all of the above information relative to the sample shall be sent by mail to the laboratory, so that in case the tag on the can becomes defaced or torn off, the information required will still be available.

The sample must represent the entire shipment, or that part of the shipment from which it is taken. The sample must be put into the air-tight container as fast as it is taken from the pile, so that it shall not have time to lose any of its moisture. Be sure that the can is well corked or sealed before shipment to the laboratory.

When a sample is received at the laboratory a record is made in the spaces provided in the heading of the report form of the number of the contract from which the sample was received, the name of the contract, the name of the dealer from whom the sand was purchased or who furnished the sample, and the location of the bank or source of the sand from which the sample was taken. If there is any designating mark which further identifies the sample, this mark is recorded under the heading "Sample Marked."

A "Laboratory Mark" is then assigned to the sample, and this is marked on the can containing the sample, or on the shipping tag attached to the can, and also on the report form.

Mixing Sample and Taking Small Samples.

The entire sample is emptied from the can in which it is received, through a coarse sieve fitting into the top of a cylindrical metal container large enough to hold the entire sample. The sieve is then removed from the top of the metal container and placed on the top of another container and the sample again passed through the sieve. This thoroughly mixes the sample, and it is then returned to the original can in which it was received, and is kept stored in that can until used.

Whenever a small sample is to be taken from the large sample, a sampling tray such as is used by assayers is employed. This sampling tray consists of a series of metal troughs held in place with open spaces between them so that when sand is poured with a sweeping side to side motion a portion of the sand is caught in the troughs and the remainder passes through the spaces between them. The portion caught by the troughs is used as the small sample, or if this portion is too large, the operation is repeated and the sample thus further reduced.

Mechanical or Granular Metric Analysis.

The entire sample as received is weighed. It is then all passed over a ¼-in. diameter round hole screen and the amount left on the screen is weighed. This coarse material is not again mixed with the sample, but is examined as to its general character and thrown away. Its general character is recorded on the report form. The per cent of the entire sample which passes through the screen is recorded.

A small sample of about 0.15 lb. is then taken from the larger sample and dried at room temperature, spread out on paper. In the winter time this drying is done over a radiator. When the small sample is dry enough to flow freely, an amount equal to 0.1 lb. x the per cent passing the ¼-in. round mesh screen is weighed out on a scale reading to 1/10000 lb. For instance, if it had been found that 2 per cent of the sample as received was retained on the ¼-in. diameter round screen, then the sample taken for analysis would be 0.098 lb. This sample is then screened successively and in the order named through screens having 5, 8, 10, 14, 20, 30, 40, 60, 80, 100 and 200 nominal meshes per lineal inch in each direction, and the number of thousandths of a pound which passes each screen is recorded in the report form. As the sample was originally equivalent to 100/1000 lb., these figures will also show the percentage of sand passing each screen.

Moisture.

A sample of about 0.12 lb. is taken from the larger sample and after weighing is spread out on paper to dry at room temperature. The sample is considered dry when it will flow freely between the fingers. It is then weighed and the ratio of the loss to the wet weight is taken as the percentage of moisture in the sample. The weight wet, the weight dry, and the percentage of moisture, are all recorded on the report form.

Tensile Strength.

In determining the tensile strength 9 briquettes are made of standard Ottawa sand and Portland cement, mixed in the proportion of 1 part of cement to 3 parts of sand by weight, in the manner prescribed for standard tests of Portland cement by the American Society of Civil Engineers. An equal number of briquettes are made of the sand under test mixed with the same proportions by weight with the same Portland cement as was used with the standard sand. The sand under test is used damp, just as it comes to the laboratory, and a correction is, therefore, to be made in weighing out the sand to allow for the moisture present. To make 9 briquettes ¾ lb. of cement and the equivalent of 2¼ lbs. of dry sand are used. The amount of damp sand taken is equal to 2.25/1 per cent of moisture in sand. This damp sand is mixed with the cement by hand and by trowel, until of a uniform color before water is added, and then enough water is added to bring the mixture to as near the consistency of the standard sand mortar as the operator can judge.

All briquettes are stored in a damp closet for 24 hours in the molds, then removed from the molds and stored in water until tested. At the age of 3 days 3 briquettes of standard sand and 3 of the sand under test are broken; 3 briquettes of each are likewise broken at the end of 7 days, and the other 3 briquettes of each sand are broken at the age of 28 days. The strength of each briquette and the average of the 3 are entered on the report form.

The per cent that the average strength of the briquettes of the sand under test is of the average strength of the briquettes of standard sand at the age of 3, 7 and 28 days is also entered on the report form. The cement used in these tensile strength tests is a mixture of several samples of cement well mixed together.

Silt, Suspension Method.

In the determination of silt, 50 cu. cm. of the sample is well compacted into a 100 cu. cm. cylindrical graduate. The graduate is then filled to the 100 cu. cm. point with water and the whole shaken violently and stirred with a paddle for 2 minutes. The water is again brought to the 100 cu. cm. mark after the air has been expelled from the sand. After a final shaking in a horizontal position the graduate is set in a vertical position and the cubic centimeters of sand are read off. It is then allowed to stand quiet until the water is clear, and the increase in cubic centimeters of solid matter is read. This increase multiplied by 2 gives the percentage of silt in the sample, and is recorded on the report form.

Silt, Wet Screening Method.

A sample of the damp sand is taken weighing the equivalent of 0.1 lb. of dry sand after the proper correction made for the moisture contained therein. This sample is then placed in a 200-mesh sieve and screened wet by holding under a stream of water. After being thoroughly washed the sand is removed from the screen and dried at room temperature and weighed. The percentage of loss in weight is recorded on the report form. With another sample the same process is followed with a 100-mesh sieve and the percentage of loss in weight is recorded.

Silt and Vegetable Matter in Sand.

Take a sample of the damp sand just as it is received in the laboratory sufficient to fill a 200 cu. cm. graduate to the 100 cu. cm. point. This sample is to be tamped into the graduate in small quantities at a time. The sand is then removed from the graduate, weighed, and the weight recorded. It is then returned to the graduate, water is added and the whole shaken violently and stirred with a rod for 2 minutes, then the dirty water is decanted into a separate vessel. More water is added, the agitation and stirring are repeated, and the dirty water is again decanted into the same vessel. This operation is repeated until the water is practically clear. The decanted water is then filtered through a previously weighed filter paper, the clear filtrate is thrown away and the residue

on the filter paper is dried, together with the filter paper, at 212 deg. After drying, the filter paper and the residue are weighed together, after deducting the weight of the filter paper the remainder is considered silt, and its weight is recorded. The percentage is recorded which the weight of the silt formed of the weight of the original sand washed.

The filter paper and the residue are then ignited in a weighed crucible at a red heat and stirred so that any carbonaceous matter may ignite. The crucible and contents are then weighed, and the weight of the contents is recorded. The loss in weight of the silt is taken to indicate the amount of vegetable matter and the percentage with the loss in weight on ignition bears to the original weight of sand is recorded and is taken as the percentage of vegetable matter in the original sample of sand.

Increase in Volume.

A sample consisting of about 550 cu. cm. is taken and dampened, if not already sufficiently damp, so that it will hold its form when squeezed in the hand, but no excess of water can be squeezed from it. About 10 cu. cm. at a time of this sand is tamped into a 200 cu. cm. cylindrical graduate with a wood tamper about 1 in. in diameter, until exactly 100 cu. cm. has been well tamped in.

This sand is emptied out of the graduate and all sand sticking to the sides of the graduate and to the tamper is cleaned off. To this sample is added 50 cu. cm. of cement. This cement is weighed and the weight taken is based on the assumption that 95 lbs. of cement has a volume of 1 cu. ft., on which assumption 50 cu. cm. of cement will weigh 0.1680 lb. This mixture is well mixed by kneading by hand, and sufficient water is added to bring the mortar to a quaking consistency. The mortar is again all tamped into the graduate, about 10 cu. cm. at a time, and the volume of the mixture is recorded on the report form. This gives the increase in volume of a 1:2 mixture over the volume of the sand under test. By adding 40 cu. cm. of cement to another 100 cu. cm. of sand the increase or change in volume of a 1:2½ mixture is obtained, and by adding 33 1-3 cu. cm., 28½ cu. cm. and 25 cu. cm. to other samples consisting of 100 cu. cm. of sand, the changes in volume of 1:3.1:3½ and 1:4 mixes respectively are ascertained and recorded on the report form.

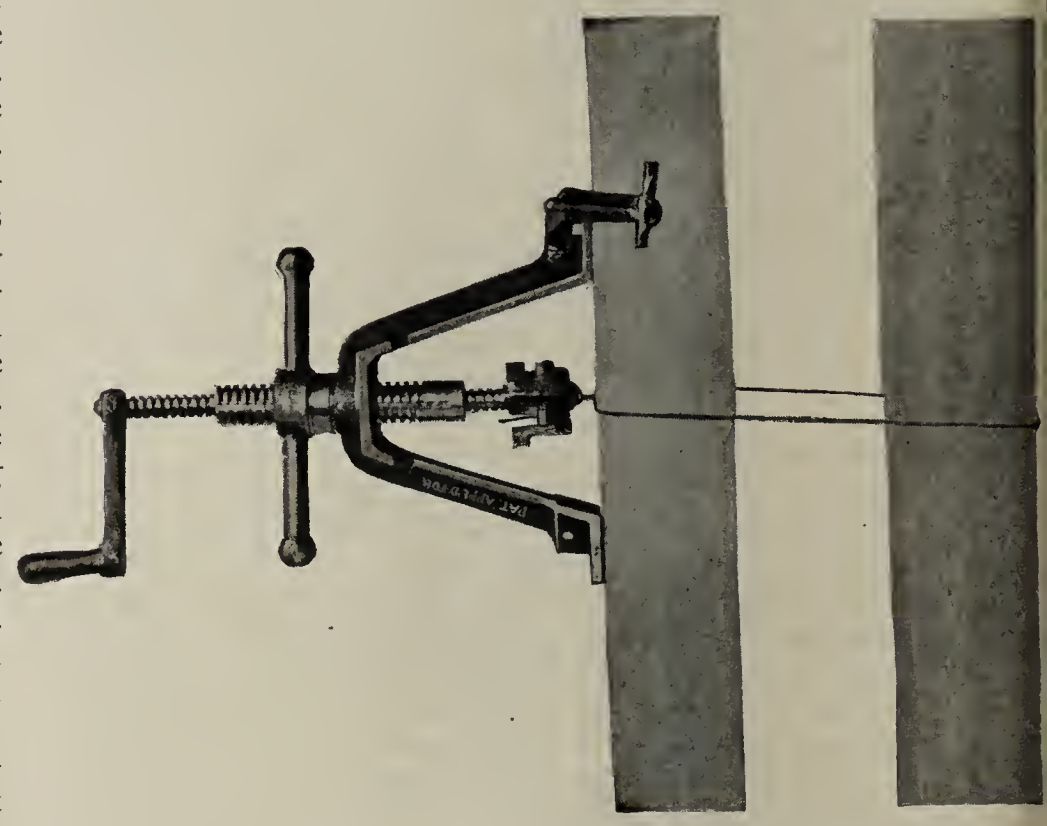
For convenience in measuring the cement accurately the following table is prepared, giving the weight in grams, ounces and grains, ounces and fractions, ounces and decimals, and in decimals of a pound of the quantity of cement required to mix with 100 cu. cm. of sand for proportions varying from 1:1 to 1:6, assuming that 95 lbs. of cement has a volume of 1 cu. ft.:

Cement, cu. cm. Weight, grams.	Weight, ozs. (avoirdupois).	Weight, ozs. and fraction; average.	Weight, ozs. and grains; average.	Weight, lb.
152.4	5.376	5⅜	5 oz. 164 gr.	0.3360
100.2	3.59	3 19/32	3 oz. 258 gr.	0.2240
76.2	2.69	2 11/16	2 oz. 302 gr.	0.1680
61.0	2.15	2 5/32	2 oz. 66 gr.	0.1340
50.8	1.79	1 51/64	1 oz. 346 gr.	0.1120
43.5	1.53	1 17/32	1 oz. 232 gr.	0.0958
38.1	1.34	1 11/32	1 oz. 149 gr.	0.0840
33.8	1.19	1 3/16	1 oz. 83 gr.	0.0745
30.5	1.075	1 5/64	1 oz. 33 gr.	0.0672
27.8	0.98	63/64	0 oz. 429 gr.	0.0611
25.4	0.90	29/32	0 oz. 394 gr.	0.0560

WIRE TIGHTENER AND TWISTER.

The Milwaukee Device Co., 1287 National avenue, Milwaukee, Wis., in a recent circular concerning their wire tightener and twister, have the following to say:

"Reduce the cost, increase the profits," is every man's aim in concrete work. This machine is the greatest money-saver of anything that ever was invented to help the concrete builder. **The Milwaukee Stay Wire Tightener and Twister** is the result of years of study right in the work. It draws the wires and twists them tight on the **outside** of the mold, in place of the old way of working on the inside of the mold, which is very slow. It can be used to wire columns and girders where it would be impossible to use wire in any other way. Where heretofore you had to use cumbersome clamps and bolts, or worse yet, spike heavy lumber around, which is a great loss. There are many clamps in the market that are good. But there is too much cumbersome material to move to and from the job and to store when not in use. With our device nearly everything is done with wire. When you take your forms apart you cut the wires and the forms come apart ready to be moved. You haven't got to have an army of men to clean it up,



In Position for Wall.

and you don't have more kindling wood than good lumber to move. We all know that it is the carpenter work that is the most expensive item in the concrete work. One thing that makes it so is that the stay wires have to be put in as the walls go up, consequently the carpenter has to do the wiring; whereas with our device the walls can be put up without stay wires, and any inexperienced man can do the wiring in one-tenth the time it would take the old way, and with one-third less wire than the old way.

Of the visitors in Chicago the past month was W. O. Matthews, manager of the Canada Pebble Company, Port Arthur, Ontario, Canada. Mr. Matthews' company has a nice business with the cement manufacturers and he anticipates making many trips to the states. He was accompanied by G. M. Thompson, one of their engineers, who calls on the trade. Mr. Matthews made a trip east including a visit to his home.

Concrete Water Tank

The Chicago City Railways recently finished a concrete tank at the 78th street plant, Chicago, which has some interesting features. The purpose of the tank is to supply pressure for sprinkling and fire protection. The specified capacity was 100,000 gallons, but the tank as constructed has a total capacity of 120,000 gallons.

The desired location of the tank was occupied by a large brick building, which it was thought inadvisable to tear down or move. The supporting columns had to be designed with enough spread to entirely clear the building. The columns have an incline equal to 14 ft. in 46 ft.; or a little less than one-third. This feature added considerable difficulty in design and construction.

There are four foundations, one under each column. Each footing is 11 feet square at the bottom, giving a total bearing area of 484 sq. ft. The bottom of this footing is reinforced in each direction by eight ⅝-in. round bars, each 10 ft. 10 ins long. This reinforcement makes it possible to make the concrete footing rather thin, and to slope it off rapidly to the top. To secure a good bond between footing columns, four ¼-in. square rods 18 ft. long, bent double, were used. These were anchored in the footing as shown, and help to resist the shear caused by the column pressure not being transmitted vertically.

The columns are 30 inches square, being designed thicker because there is no diagonal bracing. Four bars compose the reinforcement in each column, each 1⅛ in. square and 31 ft. long. These bars are overlapped 5 ft. where spliced.

The horizontal braces are rather heavily reinforced. At the joint with the columns, these braces are subject to a large bending moment on account of wind pressure. The loops shown at this joint are inserted to prevent the reinforcing rods from pulling out of the concrete when subjected to great stress.

The bottom of the tank is curved upward, and when filled with water, a pressure is developed which is counterbalanced by the downward weight of the walls of the tank. These stresses produce tensions which are taken care of by the large number of ⅝-in. square rods shown. The side walls are made 8 inches thick, and are reinforced by hoops, of the dimensions shown in the elevation, with 4-ft. laps. The roof of the tank is 4 in. thick, although 2 in. would probably suffice. It was thought advisable, however, to add the extra 2 in. for safety. The top is reinforced by a gird of iron rods at right angles.

The excavation was specified to be carried down 5 ft., but in order to get a good bearing this was increased, and the excavations were made from 7 to 10 feet deep.

The concrete for footings was mixed in the proportion of 1:2:4, using crushed stone. The mixture used in the remainder of the structure was 1:1:2. The sand was clean and well graded torpedo sand, and the stone varied from ¼ to 1 inch in size. The concrete was mixed in a batch mixer, and was made wet enough to flow freely around the reinforcement and to fill out all the corners in the forms.

Before concreting was started, the forms were thoroughly cleaned and inspected to see that the reinforcement was properly placed. When concreting after a suspension of only one day, the joints were thoroughly cleaned, drenched with water and then covered with grout. When work was suspended for a longer period, from ½ to 1 inch of the old concrete was removed before wetting and grouting.

The inside of the tank, when completed, was given 3 coats of cement from ⅛ to ¼ inch thick. The surface was previously roughened to insure a good bond. The cement finish was a mixture of 1 part cement, 1/10 part hydrated lime, and 1 part sand.

In freezing weather above 20 deg., concreting was allowed using heated water, gravel and sand, and forms were covered by tarpaulins, under which steam from the company's plant was circulated.

The reinforcement used was high carbon steel with an ultimate strength of 90,000 lbs. per sq. in.

The form work was carefully designed to support the wet concrete without deflection. Forms were built practically watertight. The boards for the columns and girders were planed on one side and two edges, and the boards for the tank form proper were matched and dressed.

The shape of the temporary tower is shown in the accompanying diagram. The peculiar shape was used so as not to interfere with the columns, which it is noted are entirely outside the tower. The pressure from the tower had to be carried to and distributed

Concrete Water Tank with Inclined Column Supports.

uniformly on the walls of the brick building (dry kiln). The entire weight of the tank was carried by this tower during construction. The pouring of the concrete was very difficult in the inclined columns. The columns were carried up to the first girder in one operation. The girders were then poured, and after that a second section of the columns, and so on. The tank was carried up in 4-foot sections.

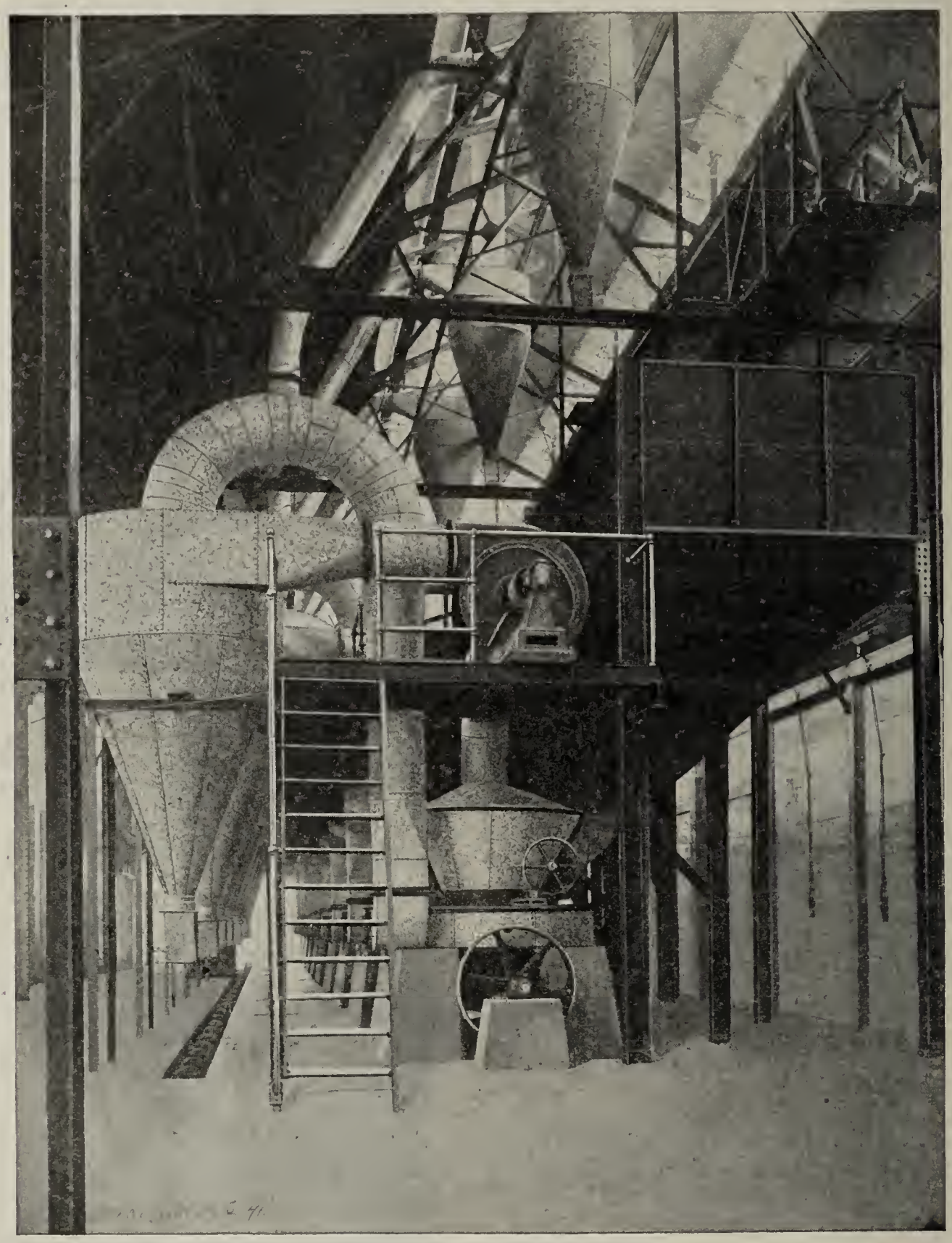
The Railway Company had much faith in the ability

of the concrete water tank to hold water, as was evidenced by its location over a dry kiln. However, the contractor was required to guarantee that the tank would be watertight, and that any defects appearing within a year would be repaired.

The tank was designed and constructed by L. J. Mensch, 138 North La Salle street, Chicago. The work was done under the supervision of Hugo Schmidt, architect for the Chicago City Railways.

SAND CONCERN WINS ITS RATE.

In the matter of the Atwood-Davis Sand Company against the Chicago & Northwestern Railroad Company, alleging discrimination in the refusal of the company to extend its rate zone to the company's plant at South Beloit, the state board of warehouse commissioners ruled if tariff zones are established the company must treat all alike and ordered the railroad to extend its tariff zone to the sand company.



No. 2. View of Raymond Cement Mill Installation in the Plant of the Crescent Portland Cement Co.

INDUSTRIAL BUILDINGS OF CONCRETE.

"Industrial Buildings of Concrete" is the title of a handsome 32-page booklet just published by Lockwood, Greene & Co., architects and engineers for industrial plants, 93 Federal St., Boston. It illustrates the more important concrete buildings designed by Lockwood, Greene & Co., showing various treatments. Anyone interested in concrete buildings should send for this booklet to the company's Boston office, as it has many points of interest.

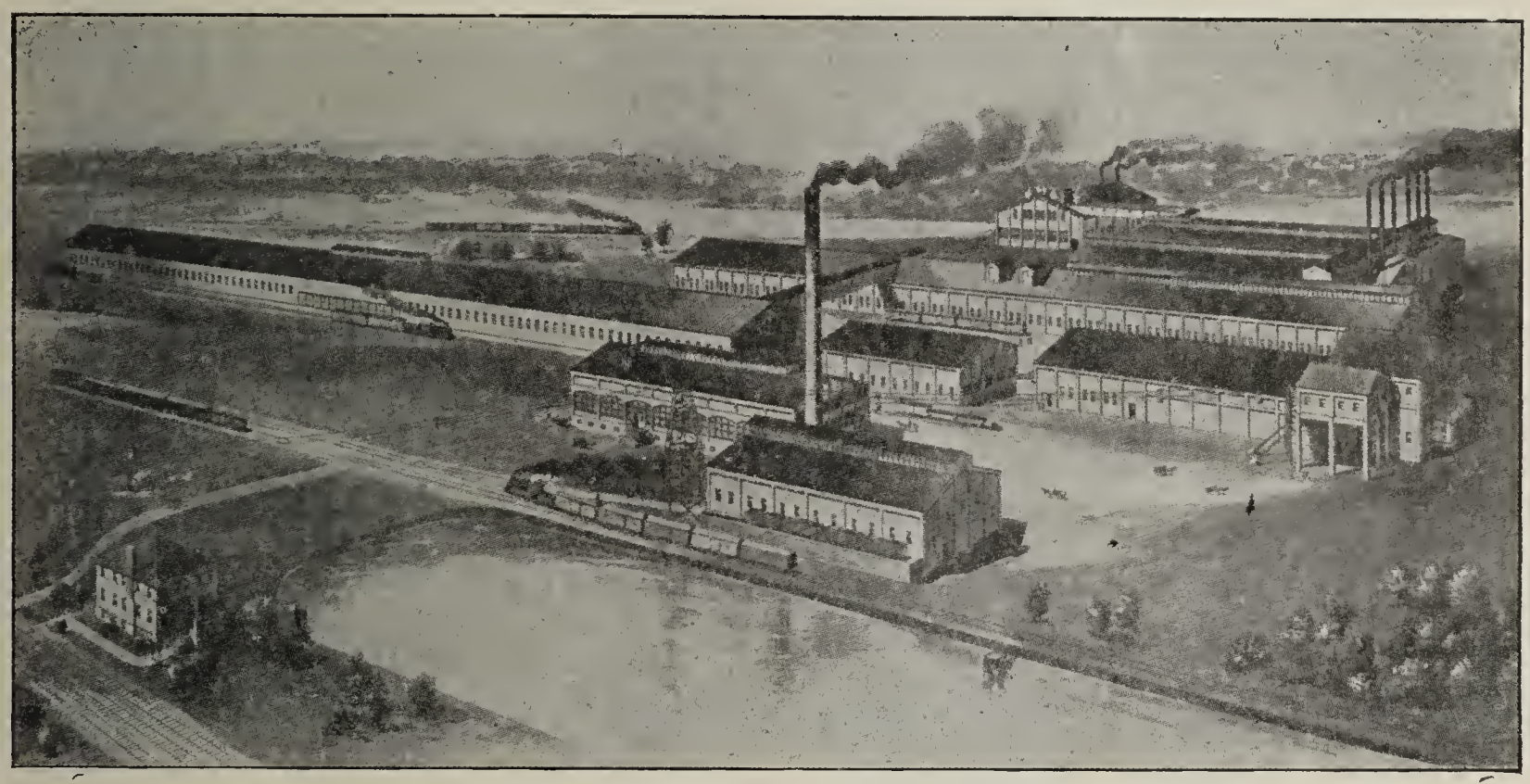
LOCOMOTIVE CRANES.

A new book now on the press, illustrating the different types of "Link Belt" locomotive cranes, will be mailed to any of the readers of Cement and Engineering News. The cranes manufactured by this company are the most easily operated, durable, accessible, simple and efficient cranes on the market today. The Link-Belt company have factories in Philadelphia, Chicago and Indianapolis, and branch offices in New York, Boston, Buffalo, Pittsburgh, St. Louis, Seattle, Denver, San Francisco and New Orleans.

The Plant of the Crescent Portland Cement Company

By W. B. Ruggles

In 1874 the Crescent Portland Cement Company was organized and the manufacture of Portland cement was begun by them at Wampum, Pa., upright kilns being used. At the Centennial Exhibition at Philadelphia in 1876 a gold medal was awarded the Crescent Portland Cement Company for the best exhibit of Portland cement. In 1901 rotary kilns were installed and the output materially increased, but as they were never able to keep up with the demand for their product, it was decided in 1908 to increase the capital stock and build a thoroughly up-to-date mill of 3,600 barrel daily capacity. The writer was engaged as engineer, and with the able assistance of R. H. Hughes, the manager of the Crescent Portland Cement Company, designed and built the new mill as it now stands. The following notes describing the equipment in detail, are of interest:



General View of the Plant of the Crescent Portland Cement Co., Wampum, Pa.; Raymond Mills; Three for Coal and Ten for Raw Material Installed in this Plant.

Location—The plant is located about one-half mile from plant No. 1 on a level plateau 110 feet above the Beaver river, between the tracks of the Pittsburgh and Lake Erie and the Erie division of the Pennsylvania railroad, each of which have sidings to the mill. The Pennsylvania have established a passenger and express station at the office of the company and have named it Crescentdale.

Buildings—The mill buildings are all built of reinforced concrete walls with steel roof trusses, steel purlins and reinforced concrete tiles. The office building is a commodious structure; the basement, chimneys and safe vaults being made of reinforced concrete, the first and second stories of concrete blocks, the third story of concrete stucco work and the roof of tile. The cement for all the buildings and tile was Crescent cement made at Mill No. 1.

The basement of the office is used as a chemical and physical laboratory; the first floor for offices, the second floor for dining room, kitchen, drawing office and three bedrooms and the third floor for four bedrooms. The building contains three lavatories and one bathroom all finished in white tile and sanitary plumbing.

Quarry—The quarry consists of 260 acres of a hard fossiliferous limestone lying in a horizontal stratum of 20 feet in thickness overlaid with shale of proper analysis to be used with the limestone in the manufacture of Portland cement. This quarry has an open face of about one-half mile in extent and lies about 100 feet above the level of the mill. The stone is quarried by means of air drills and dynamite and loaded into buckets of one ton capacity which are placed on transfer cars carrying two buckets each. These are hauled by locomotives to track scales where the limestone is weighed and the proper quantity of shale added. This shale is stored in a large bin over the track scales and by gates operated with compressed air the proper amount of shale is dumped into each bucket on top of the limestone. The cars are then allowed to run down by gravity to the loading terminal of the cableway system, where the buckets are lifted from the cars to the cableway track by compressed air and by a gong are spaced onto the carrying cable at intervals of 26 seconds, it thus being capable of delivering to the mill 1,400 tons per day of 10 hours. The loading terminal is 3,410 ft. from the crushing terminal, but being at an elevation of 100 ft. above it, no power is required in moving the rock, but the loaded buckets going down carry the empty buckets back by continuous cable.

Raw End: As the loaded buckets arrive at the crusher plant they are dumped directly into a No. 8 gyratory crusher crushing to 3-in. size; from this the rock goes directly to two No. 5 gyratory crushers, where it is reduced to 1½-in. and smaller sizes; thence by means of an automatic feeder to a pivoted bucket conveyor which carries it up over reinforced concrete

storage bins of 7,000 tons capacity. During the daytime while the crushers are in operation every other bucket is emptied into the bins and every other one carried over to the dryers. At night when the crushers are idle, the rock is drawn by stone gates into the same pivoted bucket conveyor which runs in a tunnel under the bins and the rock carried over to the dryers.

The dryers are two Class A-10 double tube machines 70-in. diameter, 35 ft. long, capable of drying 30 tons per hour each of mixed rock and shale. From the dryers the material falls directly into two pulverizing mills which reduces it to approximately 77 per cent through 20-mesh, 67 per cent through 30-mesh, 36 per cent through 100-mesh. It is then elevated and conveyed over 13 bins, each having a capacity of 70 tons, thence to the 13 raw grinding mills of a capacity of 4 tons per hour each, grinding to a fineness of 96 per cent through 100-mesh and 91 per cent through 200-mesh. The material as rapidly as it is ground is removed by fans, separated by air separators, delivered to a conveyor, conveyed and elevated to a steel bunker over the rear of kilns, which bunker has a capacity of 1,000 tons.

The kilns are six in number, 8 ft. diameter by 125 ft. long, having a clinkering capacity of over 700 bbls. per day each. Each kiln has a brick-lined stack 58-in. internal diameter, 80 ft. high, resting on top of a brick housing, each housing is built with a dust settling chamber and all dust is returned to the raw material conveyor and thoroughly mixed with the finished material. The pulverized coal is fed to kilns by a specially designed coal feeder and from the feeder is blown into kilns by compressed air at a pressure of 70 lb. Although compressed air is more expensive to operate than a fan blast for this purpose, it has proven its value in this plant by making it possible to control easily the burning zone, thus eliminating all trouble from rings forming in the kilns and stoppages due to them.

From the kilns the clinker is conveyed in three clinker carriers, is elevated and delivered outside the wall of the kiln building, which was built to sustain the necessary pressure. The carriers are now being extended to distribute the clinker over an area of 120 ft. x 120 ft. The carriers will return to the mill through the tunnels under the clinker pile so that the same buckets which carry out the hot clinker can return the cooled clinker to the mill.

From the carriers, the cold clinker is conveyed by an open pan conveyor or two pot crushers, from which it is elevated to an automatic weighing device, at which point the gypsum is added by hand. It then goes to six bins over six preliminary grinding mills; these bins having a capacity of 370 bbls each. In the mills it is ground at the rate of 30 bbls. per hour each to a fineness of 100 per cent through 20 mesh, 98 per cent through 30 mesh and 59 per cent through 100 mesh; it is then finished in seven tube mills 6 ft. diameter, 22 ft. long, to the requisite fineness, weighed in an automatic scale and conveyed to stock house.

Stock House: The original stock house is 280 ft. long, 90 ft. wide, with reinforced concrete walls, steel columns, rafters and purlins and a reinforced concrete tile roof, and is designed to hold 100,000 bbls.; 60 ft. of the length is occupied at the north end by the packing room. The entire floor is 4 ft. 6 in. above the track level on each side. The storage space is 220 ft. x 90 ft., is divided longitudinally by a 4 ft. passageway in which is a 16 in. screw conveyor. The space each side of this passageway is divided into 11 bins 20 ft. wide. In the center of each bin below the floor is a 12 in. conveyor driven from outside the bin by a portable back geared motor and chain.

The cement is thus delivered in the packing room to six bins over packing spouts and to three bins over Bates packers. The bin walls are made by 2-in. planking between steel columns and braced by buckstays and tie rods. The outside walls are expanded metal and cement mortar stucco.

The addition to stock house now being built will be 90 ft. wide, 220 ft. long, but with side walls 25 ft. high instead of 17 ft. as originally designed and will hold 150,000 bbls. This will have reinforced concrete sides, ends and division walls with three longitudinal tunnels 5 ft. wide, 7 ft. high, partially underneath the floor. In each of these will be a 16-in. conveyor into which cement can be drawn from the bins above and conveyed to the packing room which will then be in the center of the completed stock house.

In the present packing room is a bag cleaning wheel and repair room. This will be removed to a new bag house now being built, 60 ft. x 100 ft., across the tracks from the packing room, leaving space there for the addition of more packers.

The cleaning wheel, about 20 ft. in diameter and 6 ft. long, was made on the ground out of wood with a steel shaft; the outside periphery being made with slats and the whole enclosed in a casing of sealed boards. Bags are thrown into the wheel, which is revolved, the cement from the sacks falling into a pit below, where it is automatically removed. The cement recovery from the sacks is sufficient to pay all costs of cleaning and repairs.

Power Plant: The boiler house originally contained eight 300-H. P. water tube boilers equipped with stokers and fed by a traveling coal elevator. There has since been added two 500-H. P. water tube boilers equipped with stokers which give ample reserve for all emergencies. These are also fed by the same traveling elevator and one man can easily stoke all the boilers. Under all boilers is an ash tunnel with ash hoppers under each boiler. The ashes are dumped from these into a dump car, pushed to end of tunnel, elevated by a compressed air elevator and disposed of on available adjacent ground. The stack for the original battery of boilers is of reinforced concrete 9 ft. internal diameter, 180 ft. high. The two new boilers have a single steel stack 6 ft. diameter by 175 ft. high.

The basement of power house is 10 ft. in height, in which are located four feed water pumps, one engine driven and one motor driven condenser circulating pump, one dry vacuum pump, all the steam, exhaust, water and air piping, also tanks, filters and pumps for an automatic oiling system for all engines and compressors.

In the engine room are three 1,200-H. P. cross compound condensing engines direct connected to 1,000 K. W. alternating 480 volts, 60 cycle, 3 phase generators, two 150-H. P. high speed engines direct connected to 90 K. W. direct current 110 volt generators for excitation of the alternating field; two air compressors each capable of compressing 1,400 cu. ft. of free air per minute to 100 lbs. pressure, a reserve dry vacuum and a ten panel switchboard.

The condenser, which is located outside of power house, is of the barometric type.

Water Works: As the mill stands 110 ft. above the Beaver River, the only available water supply, advantage was taken of a natural depression between the mill and the Pennsylvania Railroad for a reservoir. A reinforced concrete dam was built 275 ft. long, 18 ft. high, which forms a reservoir holding about 28,000,000 gal.

In the river 110 ft. below the plant is built a reinforced concrete pump house containing a centrifugal

pump direct connected to a 150-H. P. motor. Water is pumped to the top of the hill, where it empties into a small concrete cistern, from which it flows by gravity through a 24-in. tile pipe 600 ft. long into the reservoir, the pipe being carried to the bottom near the dam. Water for the condensor and boiler feed is pumped back through a section of this tile pipe.

The hot water from the condensor flows back to the reservoir near the upper end and by a dyke the water is compelled to flow entirely around the reservoir before again being used. Pumping about 10 hours per week is sufficient to make up for seepage and evaporating.

Coal House: In the coal house are two double tube Class A-8 dryers 60 in. diameter, 30 ft. long, capable of drying eight tons of coal per hour each, three grinding mills and air separators which deliver the pulverized coal to an elevated conveyor running to the kiln building. The coal house is operated but ten hours per day.

The entire plant is operated by alternating induction motors of the squirrel cage type, and is lighted by mercury lamps supplemented by incandescent lamps where needed.

Just before the completion of the plant, Mr. Prentice, then president, died, and his position was immediately filled by the election of David M. Kirk, of Pittsburgh. The financial and mechanical success of the company is very largely due to Mr. Kirk's able and energetic administration. He has with Mr. R. H. Hughes as manager, Mr. Hayes as superintendent, Mr. Toler as steam and electrical engineer and Mr. Hasse as chemist, a capable and loyal corps of assistants.

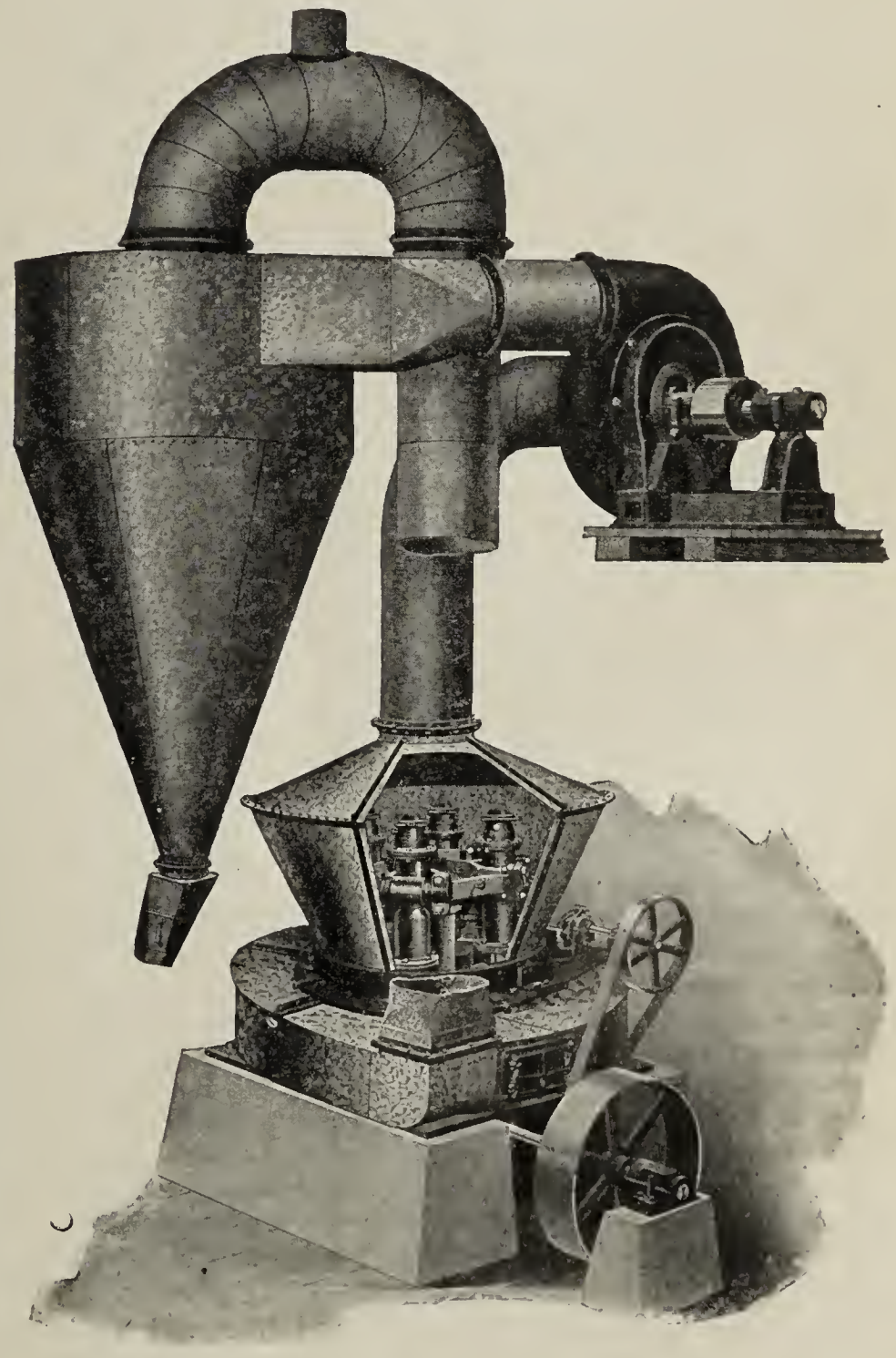
Raymond Pulverizer and Air Separator

The Raymond System of grinding and separating is based on new principles and its success in a large number of cement plants justifies the manufacturers in claiming that it has revolutionized this important department of cement manufacture. The Raymond Mill reduces the coal or raw material to a very uniform product of any desired degree of fineness, insuring great economy in the use of coal, perfect combustion and a very superior quality of cement. The manufacturers claim that the output of kilns has been increased more than 20 per cent in many instances by the installation of this system. The company makes a special point of carefully studying the individual requirements of each plant and of designing an installation that will be most economical and thoroughly effective. This service continues after the purchase of the machinery as well as before.

Of the two illustrations presented herewith, No. 1 shows the Raymond standard "Four-Roller" mill, with the rollers suspended and the pneumatic separator with a revolving disc taking the place of the inner cone in the standard separators. The suspended roller mill has been on the market so long that its merits are known to all engineers.

In the early mills of this type, the mill was surrounded by a screen through which the material had to pass, and when a fine finished product was desired, it became necessary to use a fine mesh screen or bolt the material outside the mill and return the tailings. The expense and trouble of bolters are well known and a screen sufficiently fine in a mill would clog on most material, or at least so greatly reduce the mill's capacity as to destroy its economy. In the present construction the air separator is attached and the air is admitted underneath the grinding surface, taking the material away by the air current as quickly as it is reduced by the rolls, thus keeping the mill free from fine material, which in mills without air separation keeps the rolls from operating on coarse material, as well as clogging the screens. The coarse carried up by the air current is separated from the fine in the separator, the fine being carried directly to the receiving receptacle by the air current and the coarse being returned to the mill in a continuous stream from the edge of the revolving disc, over which a thin sheet of air at high velocity is constantly passing. These features give the rolls the highest possible efficiency and account for the enormous capacity per horse-power, at the same time insuring a finished product of uniform fineness.

Illustration No. 2 shows a typical installation of ten Raymond mills grinding raw material in the Crescent Portland cement plant at Wampum, Pa. Cyclone collectors in this case discharge the material into a conveyor underneath the floor line, the conveyor discharging into a centrally located elevator which takes



No. 1. Raymond Low Separator Roller Mill.

the pulverized material to the stock bins over the kilns. In this illustration can be seen the spout between the stock bins and the feed hopper on the mill, also the drag conveyor feeding stock bins. The secondary collectors are shown in the extreme top of building.

The Raymond Brothers Impact Pulverizer Co., of 1500 West Harrison street, Chicago, Ill., are the manufacturers of this system, from whom additional information may be obtained.

NORTHWESTERN AND MIRACLE CONSOLIDATE.

What is considered to be the largest deal ever consummated in the history of concrete machinery and tool manufacturing—in importance of the transaction, in money involved, and in extent of interests affected—is the consolidation of the Miracle Pressed Stone Co., of Minneapolis, Minn., with the Northwestern Steel & Iron Works, of Eau Claire, Wis.

Both concerns are very well known, do an enormous business, and enjoy a high reputation among concrete workers and contractors, both for the quality of their products and the excellent service they render. One can gather an idea of the immensity of the transaction from the fact that this consolidation will give them the distinction of being the largest makers of concrete machinery in the world.

The Northwestern line has been established for the past decade, and its machinery and tools are used in every country on the globe where concrete is employed in any form of construction. It meets the big demand for medium-priced machinery, and is considered to be the most complete line on the market, offering every conceivable kind of machine, tool, or mold necessary for successful results in all kinds of concrete work.

The Miracle line—consisting of concrete machines of single and double staggered air-space, two-piece wall-block machines, brick machines, mixers, tile molds, ornamental molds, and molds for cornices, chimneys, piers, burial vaults, etc.—is one of the oldest lines in existence, is well advertised, and is thoroughly known to all contractors and concrete workers in the United States. It has a reputation for its many exclusive features and established quality.

The consolidation of these two giants of the concrete machinery manufacturing business means a great deal to the trade and to all interested in concrete construction. It enlarges the scope of the company to the extent of doubling their entire output, thereby greatly reducing manufacturing cost to contractors.

The Minneapolis plant will be abandoned, and all machinery, stock, etc., will be moved to Eau Claire, where the manufacturing will be done in the immense plant of the Northwestern Steel & Iron Works. This last step was taken because of adequate facilities, added conveniences, and more space afforded at the Eau Claire plant.

This merger marks an epoch in the concrete machinery industry.

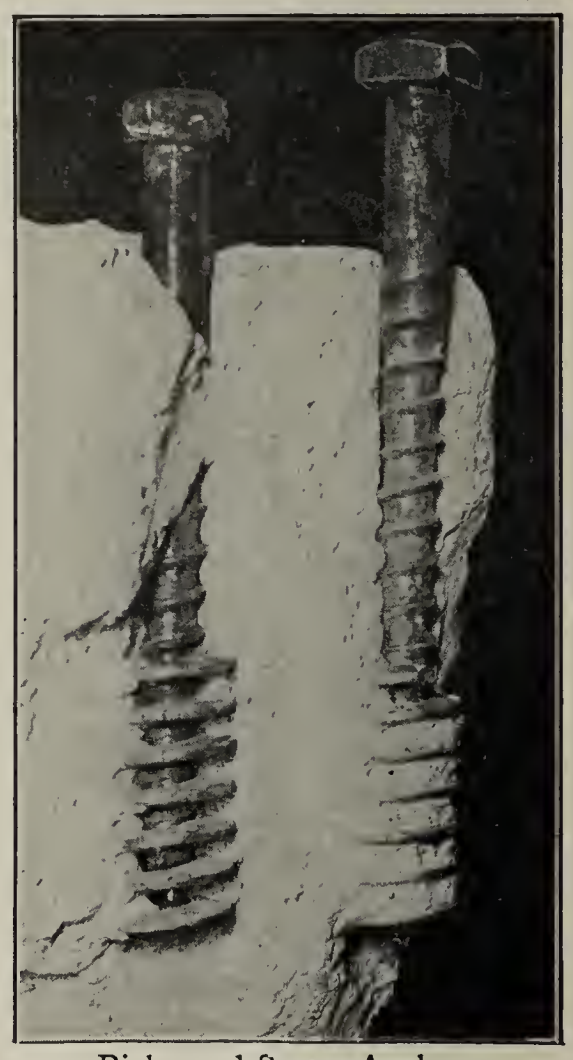
DUST COLLECTOR.

Mr. T. H. Wilson, works manager, Wilson Portland Cement Co., Ltd., Warkworth, New Zealand, writes that they would like to hear from manufacturers of a dust collecting apparatus that will minimize the dust coming from rotary chimneys. They have two 6x60 ft. and one 8x100 ft. kilns and would like to install some apparatus, as they are losing a great deal of dust through these chimneys.

THE RICHMOND SCREW ANCHOR.

The great difficulty in using bolts or screws in concrete, stone or similar materials, because the close threads of the screw do not of themselves provide sufficient bearing surface to sustain a load, led to the production of the RICHMOND SCREW ANCHOR, a device that brings into action a large area of holding material and furnishes a permanent metal lined screw hole. It is claimed that this anchor will last indefinitely and that it will not wear out, tear out, chip off or enlarge under vibration, the load on the screw or because the screw is inserted and removed repeatedly. Another claim is that when properly and deeply bedded, the anchor will not pull out before the bolt itself fails.

When concrete work is in course of construction the anchor and screw may be placed in final position through a hole in the forms, and the concrete allowed to harden around them, or if this is not convenient the usual method of drilling a hole in the hard concrete may be employed and the bolt and anchor cemented into the hole with neat cement. This latter process is, of course, the only one applicable to stone, brick and similar materials. After the concrete or cement



Richmond Screw Anchor.

has hardened, the bolt can be easily removed with a wrench, leaving the anchor in the material. For railings and other positions where lead can be poured into the drilled hole, this method is also employed to produce immediate results, such as are desired for railings of subway platforms.

The uses of this device are both extensive and varied, including as they do the entire field of expansion shield work and a great many instances where the expansion shield can not be conveniently used.

For certain classes of work in which the bolt may need to be permanently removed after a period of use, this anchor is desirable, as only a hole the diameter of the bolt is visible and can be easily closed, or can be closed permanently with a cork or a dab of plaster.

In durability, the device should show up well, as the anchor is completely encased in masonry and cannot rust, while the bolt can be completely galvanized

after the threads are cut, an impossibility in the case of screws to be used in shields or nuts whose threads have to be recut after galvanizing.

In Europe, this device has probably reached its greatest application, the sales of one form alone, the Thiollier Helical Lining for screw spikes for rails, having reached many millions annually, while a single recent order in this country (for the Union and Southern Pacific Railroad) called for 620,000 pieces.

Other applications are found in the bolting of machinery, shafting, piping and fixtures in concrete structures, anchoring windmill and water towers, fastening awning fixtures in concrete, benches in grandstands, fencing to concrete posts, and steps, etc., to concrete poles in which the anchor, instead of weakening the structure, actually reinforces it.

Although perfectly applicable to small wood screws, the main field of application has been in heavy concrete work requiring bolts of the lag screw type and from 3/8-inch to an inch or more in diameter.

The patents for this device are controlled by the manufacturers, the RICHMOND SCREW ANCHOR CO., of 11 Church St., New York City.

AMERICAN ROAD BUILDERS' ASSOCIATION.

The invitation extended by the Mayor and the Commercial Association of the city of Cincinnati to the American Road Builders' Association to hold its Ninth Annual Convention in that city has been accepted. The convention and the American Good Roads Congress, which is held in connection with the convention, will, therefore, be held in Music Hall, Cincinnati, December 3, 4, 5 and 6.

In connection with the annual convention of the association, there will be held, as usual, an exhibition of machinery, materials and methods of road construction in Music Hall in space which has been set aside for the purpose. The building has a floor space of over 50,000 square feet, and it is expected that all this space will be required for the exhibits. Not only will the manufacturers of material and machinery be represented in this exhibition, but the several states will have booths set aside for them in which they will exhibit models of roads, photographs, drawings, road materials, etc. This feature will be especially attractive to road builders.

The American Road Builders' Association was organized in 1902. It is, therefore, the oldest organization of its kind. Its conventions bring together the experts of the country engaged in the work of laying out and supervising road and street construction and maintenance. The president of the association is Nelson P. Lewis, Chief Engineer Board of Estimate and Apportionment of New York City; First Vice-President, Harold Parker, ex-Chairman of the Massachusetts State Highway Commission; Treasurer, Major W. W. Crosby, Consulting Engineer of the Maryland State Highway Commission; Secretary, E. L. Powers, Editor and Publisher of "Good Roads." Among the directors of the association are: W. A. McLean, Provincial Engineer of Highways of Ontario; Arthur W. Dean, Chief Engineer, Massachusetts Highway Commission; S. D. Foster, Chief Engineer, State Highway, Department of Pennsylvania; W. J. Roberts, State Highway Commissioner of Washington; James H. MacDonald, State Highway Commissioner of Connecticut; Austin B. Fletcher, State Highway Engineer of California; John R. Rablin, Chief Engineer, Metropolitan Park Commission of Boston; R. A. Meeker, State Highway Engineer of New Jersey, and Mr. H. Connell, Chief of the Bureau of Highways and Street Cleaning of Philadelphia.

"OBSTITCH" DIAMOND REINFORCEMENT BELTING.

For some time past there has been a growing demand by users of wide and heavy belts for the very best belt they can find, even though the first cost be greater.

With this incentive the Mount Vernon Belting Co., of Baltimore, Md., have devoted a great deal of time, work and study to perfect a belt that would meet every requirement in strength, adaptation and longevity, and in their "Obstitch" have accomplished this end.

The construction of the "Obstitch" with diamond reinforcement shows the best quality of material and workmanship in every part. It is made from a specially constructed cotton duck weighing 34 ounces to the square yard—weight positively guaranteed—and this extra weight, being added in the wrap threads, gives it a very high tensile strength.

It is treated by two distinctive processes, making the belt an absolute water, alkali and acid resistant. The one for general transmission and carrying purposes is finished yellow, and the other, finished black, is treated specially for extremely hot places, such as carrying of hot clinkers, clay, etc.

The "Obstitch" has been subjected to the most severe practical tests against several of the oldest and most widely known textile belts in the world, with results that it gave from 75 to 100 per cent better service than any of them.

LINK-BELT STEEL CHAINS.

Book No. 124 of the Link-Belt Co., of Chicago and Philadelphia, deals in detail with the various kinds and grades of Ewart detachable Link-Belt chains, for which this company is famous. Made of refined malleable iron, these chains have proven to be unsurpassed at all cement plants under the most trying conditions. Copies of the book will be sent free on request.

HOTCHKISS STEEL SIDEWALK FORMS.

A handsome booklet entitled "Sidewalk Science," describing the Hotchkiss Steel Sidewalk forms, is just off the press and will be sent to interested parties on request. Write also for information concerning Hotchkiss curb and gutter forms. Our readers' attention is called to two letters recently received from users of the Hotchkiss forms, viz:

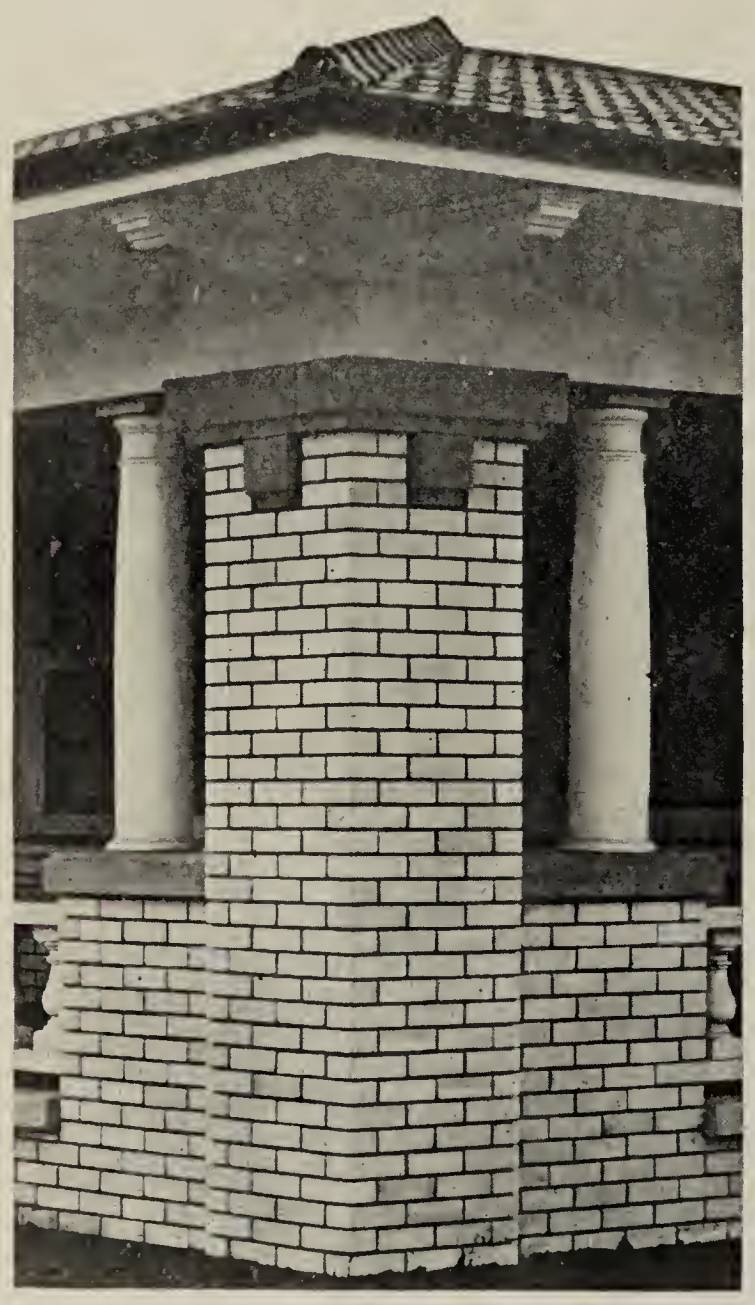
"As our contract for 105,000 square feet is near completion, we wish to say that your forms have been of great assistance to us on this work. They have done for us all that you recommend. We are greatly pleased with them and we take pleasure in recommending these forms to all contractors in municipal work." Mulderry Bros., Albany, N. Y.

"Your forms received Friday, the first and used the same day. * * * It was 8:30 when they were delivered on the job by the express company. * * * I used small mixer and three men besides myself. * * * I set the first 10-foot section and started concreting and topping, and continued setting forms until first section was ready to float. It had been many a day since I finished sidewalk, but I wished to try these forms personally to see their advantages and not be forced to take a finisher's word as to whether they were the thing or not. We finished the stretch (100x5 feet) at 4:15, covered with canvas and stretched 30-inch wire completely around it. * * * It is hardly necessary for a man to try these forms over a day to appreciate their money-saving qualities as well as the improvement in alignment over the old style construction." L. R. Williams, Bartlesville, Okla.

Sand—Lime Brick; How Manufactured and Used

Many architects, builders and owners do not know that first quality sandstone, or sandlime, brick are obtainable in the local markets in any quantity. Yet the use of sandstone brick, owing to its peculiar adaptability for ornamental purposes, is constantly extending and builders are now coming to employ it for not only special detail work but also for general face brick for the exteriors of buildings of all kinds. Particularly where contrast in colors is desired it meets a want which clay brick cannot fill. Being snow white, this standstone brick is in a class by itself, having created a special place for itself in mantel work, porch facing and pillars, exterior chimneys, facing veneer and for trim in connection with other materials.

Sandstone brick differs from ordinary brick and facing materials in composition, says the Southwest Contractor and Manufacturer of Los Angeles, Calif., for it is made from sand and lime, scientifically proportioned and treated. There is only one firm in Southern California manufacturing it, the Furlow Pressed Brick Company, incorporated with $50,000



Sandstone Brick Set in Black Mortar.

paid-in capitalization. Its plant is at Redondo, situated behind immense sand dunes, which furnish an inexhaustible supply of clean sand of the quality demanded. The operation of the plant is in the hands of expert sandstone brickmakers and the manufacturers are turning out a better product today than has ever before been obtainable in Southern California. In fact, so far as quality is concerned, there is no comparison with the standstone brick offered the local market today with that produced three or four years ago, when the plant was first established. New machinery was installed two years ago and new and improved methods of manufacture have been inaugurated until today the Redondo plant is turning out a quality of brick equal to any sandstone brick obtainable even in Germany, where the manufacture of this kind of brick originated.

The equipment of the Redondo plant is designed to handle the raw materials scientifically as well as economically. The problem of overcoming porousness has been solved by pulverizing a large percentage of the sand so that when compressed under the terrific pressure of the molding machinery all voids in the material are effectually closed and a brick is produced much more waterproof than the ordinary clay face brick.

Doubtless few understand the processes of manufacture of standstone brick or appreciate the facilities that have been gathered together at the Redondo plant for turning out this product. Many connected with the building trades know such a plant exists, but it is not common knowledge perhaps that the factory is capable of producing 17,500 brick a day and that the original equipment represents an investment of some $85,000.

The Furlow Pressed Brick Company utilizes five and a third acres of ground at its plant, part of the area being raw supply in the form of huge sand dunes. This comprises a natural supply of fine clean sand that is quite inexhaustible, for the west winds continually replenish the supply, sometimes more quickly than the material is used. Occasionally the sand is blown in huge drifts that endanger the rear walls of the factory building and has to be removed by other means than the ever-hungry endless chain bucket conveyors, which elevate the sand used in the factory, to the drying kilns.

So the bulk of the raw material is brought to the door of the factory without expense. Ordinarily the sand can be used by the grinding machinery without drying. This is so during the summer months. But during the rainy season the sand must pass through the heat of the drying kilns to eliminate all moisture, for absolutely dry sand is essential to successful manufacture. A portion of the sand, that which forms the coarser bulk of the brick, is not passed through the grinding mills, but elevated automatically to the storage bins under the roof of the factory. A large percentage of the sand, however, is pulverized so that it will pass through a 100-mesh screen. The lime, which is obtained in carload lots from Arizona, is also ground. This process is accomplished by a Fuller-Lehigh ball mill with a daily capacity of 40 tons, the mill being speeded to 210 revolutions per minute. This mill is similar to the ball mills in common use in the manufacture of Portland cement. The sand and lime, automatically proportioned by weight, are fed into the ball mill automatically and ground together. From the ball mill the material is blown by compressed air through a 100-mesh screen and elevated by buckets on endless chain to a height of 65 feet, where it is received in the steel storage bins. Half of the storage bin contains the pulverized material and half the bulk sand. From the storage bins the sand and ground material is fed into a large pug

mill, first being automatically measured by weight, where it is thoroughly mixed and the desired proportion of water added automatically by weight. From the pug or mixing mill the material is dumped into the silo, where it is partially hydrated.

From the silo the material is next carried to the brick press by screw conveyors. The press is a 200-ton brick press, automatically fed and pressing four brick at a time. It requires three men to operate this press, their attention being required every second in removing the green brick from the press and transporting them on the small steel cars which carry them into the hydrating kilns. When green the brick have to be handled very tenderly and expertly to avoid marring the surface or injuring the fine edges. The operators use rubber finger tips to facilitate their work.

The final process, curing the green pressed brick, is accomplished not by the direct contact of fire as in clay brick manufacture, but by "hydrating," or subjecting the brick for a period of ten hours to 120 lbs. live steam pressure. An automatic register keeps detailed record of the pressure during the entire curing period. This process takes place in the airtight steel cylinder of 6½-ft. diameter and 70-ft. long. When

Steam Cylinders for Hydrating Sandstone Brick.

the green brick enter the curing kilns they are dark gray in color; when they are taken out they are light gray and are soon as hard as cured cement rock. The Furlow company's brick, by the way, are said to test under hydraulic pressure as high as 60 tons.

The Furlow plant is completely equipped with power machinery. The power equipment consists of a 125-h. p. oil burning boiler; 125-h. p. Corliss engine; a 200-light dynamo operated by a smaller auxiliary steam engine when the larger engine is not in use. The dynamo furnishes light for all parts of the plant and enables its operation both day and night.

JEFFREY MANUFACTURING CO.

The Jeffrey Manufacturing Co. have moved their Chicago headquarters and offices from the Fisher building to the McCormick building, recently completed and which is considered the most modern and up-to-date fireproof office building in Chicago.

Mr. S. S. Shive, sales engineer, is the district manager in charge of the Chicago office, and Jeffrey customers and friends will find a welcome on the seventeenth floor, where the Jeffrey offices are located.

The Jeffrey Manufacturing Co. maintain fourteen branch offices in the United States and over one hundred agents in the leading commercial centers all over the world.

SELLS HIGH GRADE SAND AND GRAVEL.

The Rochester Sand Company, which was organized by well-known Detroit men to take over the gravel pits of the National Pressed Brick Company, near Rochester, Mich., is developing the property in a splendid manner. The pit is of large dimensions and contains sand of all grades, core sand predominating. The company is giving special attention to its core sand deposit, which is of remarkably high grade. The sand is now being supplied to such concerns as the Cadillac Motor Car Company, the Packard Motor Car Company and other concerns that find it necessary to use the highest grade of sand in making their castings. Frank A. Hughes, formerly with the Cadillac Motor Car Company, is the company's sand expert, and there is no better man in that line of work. He is giving his personal attention to orders for sand. It is not to be understood that the company deals only in core sand. Its building sand is of the highest quality and it also supplies all grades of gravel.

The stockholders of the Rochester Sand Company are Wm. Malow, the well-known Detroit contractor; E. E. Cote, Dayton, O., and W. Reich, Detroit. The company's offices are at 72 Home Bank Building, Detroit.

BOOK REVIEWS.

There is perhaps no name more familiar to manufacturers of Portland cement than that of Richard K. Meade, the chemist, who has had such a large part in the development of the Portland cement industry in the United States. Mr. Meade is now general manager of the Tidewater Portland Cement Company.

His book, entitled "Portland Cement," which takes up its composition, raw materials, manufacture, tests and analysis, is one of the standard volumes in the industry and will be for some time to come, since it has just been revised down to date and the second edition has been issued by the publishers, the Chemical Publishing Company.

In this second edition the entire text of the book has been revised and much new matter has been added, particularly to the section on manufacture, which has been increased about 70 pages. This has been made necessary in order to include descriptions of all the newer appliances for the manufacture of Portland cement, making this department fully representative of the present state of the industry. The other sections of the book have also been revised correspondingly, bringing them up to date.

The book as revised comprises over 500 pages with a large number of illustrations and complete index. The price is $4.50, and will be sent by Cement & Engineering News, 1117 Schiller Bldg., Chicago, Ill., on receipt of price.

Electricity in Stone Quarries and Gravel Pits

Advantages of Electric Drive—Selection of Motors—Power Epuipment—Typical Installations—Data Sheets

The fact that the majority of stone quarries and gravel pits can be taken on as "off-peak" business is alone of sufficient importance to stimulate central stations to greater activity in their campaign for this business. If operations are carried on during the winter months the fact that a special low off-peak rate can be secured by remaining off the peak during "lighting" months will influence superintendents to arrange their operations so as to avail themselves of this rate. The large plants, turning out enormous quantities of crushed stone and gravel, usually operate all year, save for occasional shut downs for overhauling, and therefore cannot be classed as off-peak business. However, even where the regular rates based on maximum demand are charged, these plants, although most of them have a high demand, can purchase current from a central station and thereby effect a considerable saving over steam operation. The plants of Dolese & Shepherd and the United States Crushed Stone Company, both located near Chicago, are excellent examples of this, both having purchased current for a number of years and made accurate cost comparisons.

With few exceptions, the numerous advantages of electric motor drive that apply in so many industries apply equally as well in the quarry and gravel industry. The efficiency of the electric motor, its rugged construction and its ability to operate under the most severe conditions are particularly desirable characteristics for this service. Also, electric drive minimizes the danger of accidents and delays, and by means of suitably located remote-control switches make it possible to shut down the entire plant in case of emergency. This latter feature is of great importance in stone quarries.

In soliciting the adoption of electric drive for stone quarries and gravel pits a large proportion of success depends upon the attitude of the central station power solicitor to correctly analyze existing plant-operating expenses and fixed charges. Ability to do this readily and correctly will go far to demonstrate definitely and convincingly to a prospect the flaws and waste and general field for improvement in his power layout.

In the great majority of cases the power solicitor has to contend with a present steam plant and must convince the owner that electric drive with energy purchased from the central station will not only mean a saving but a saving sufficient to permit of scrapping the present steam plant—which course is almost universally necessary.

The steam plant of a stone quarry or gravel pit is, in the vast majority of cases, an exceptionally inefficient one, operating under adverse conditions and with great losses. The buildings are more or less temporary and in their construction practically no attention is given to such items as economy in handling fuel and ashes, draft for furnaces, steam piping, etc. Machinery is usually of an inexpensive and inefficient character, and as a result enormous amounts must continually be spent for repairs and renewals. Trouble is also being encountered with boilers due to muddy water usually found at quarry sites. When these conditions are figured on a basis of dollars and cents, and then compared with the cost of equipping the plant with motors and the operating costs with electric drive it certainly should not be difficult for central stations to secure this business.

Selection of Motors.

The Public Service Company of Northern Illinois is giving the stone-quarry proposition very careful study and its engineers are working in very close harmony with all of the plants in its territory. The company is enthusiastic in promoting all new styles of machinery which will render more efficient its customers' plants and reduce operating costs in either the investment, labor, or power-consumption items.

Electric drive from the lines of the Public Service Company is proving highly satisfactory to stone quarries in Northern Illinois. The company is offering special "non-peak" rates to all quarries who will agree not to operate their plants between the hours of 4 p. m. and 8 p. m. during the months of November, December, January and February. These rates have proven so satisfactory to existing customers that only within the last few weeks other quarries have abandoned the use of their steam plants and executed five-year contracts with the company for electric power.

The engineers of the Public Service Company, in their work of laying out the motor equipment for quarries, are recommending certain features which, coming from a company of this size and experience, are of interest.

Motors for Crushers. It is recommended that where crushers are driven by individual motors, all such motors be of the slip-ring, or wound-motor type, from a 15-horsepower motor driving a No. 3 crusher, upwards. Slip-ring motors have a very much stronger starting torque than do the squirrel-cage type of motors, and in case crushers are accidentally or intentionally shut down when full of rock it is often possible, by backing the belt up six or eight feet, to start the crusher with a slip-ring motor, without cleaning out all of the rock as it is necessary to do if a squirrel-cage motor is used. This feature will at times save from 15 minutes to two hours' time in the operation of the crusher plant. Along these lines it is recommended that belts to crushers be of the highest grade and amply large so as to stand undue strain or slippage under such extreme starting conditions. It is strongly advised that all motors throughout the plant shall be equipped with dustproof bearings.

Motors for Bucket Elevators. As with crushers, these engineers approve of the use of the slip-ring motors on bucket elevators, where the elevators are of comparatively large size and driven by individual motors. At times when the elevator boot becomes filled with rock, due to some stoppage of the elevator, it is possible to start same more slowly, with more power and under better control with the multiple-point starting apparatus of the slip-ring motor than with the two-point starting apparatus of the squirrel-cage motor.

Pumping. Centrifugal pumps are being recommended for all quarry purposes, the usual foot valve being placed on the suction and the check valve being put immediately above the pump in the discharge line to prevent water-hammer damaging the pump. For all quarries of average size, the company's engineers are recommending centrifugal pumps of about 400-gallons-per-minute capacity; the reason for adopting this size is that one pump of this size seems to take care of the average seepage into this size of quarry and under none of the local conditions does this size pump require more than a 30-horsepower motor. The Public Service Company's rules require that all motors of 35-horsepower or more to be attached to its

lines shall be of the slip-ring type and the engineers appreciate that it is desirable in a great many cases to have the starting and stopping of the pump control from a point considerably distant from the pump and that such control is far more easily effected with a squirrel-cage motor driving the pump than with a slip-ring motor. If a pumpage of more than 400 gallons per minute is desired from a quarry it is often desirable to pump at more than one point, as the installation of two units causes a more flexible and efficient system. These engineers strongly recommend that all motors used for driving quarry pumps shall have impregnated windings so as to render the windings more impervious to moisture than are the winds of standard motors.

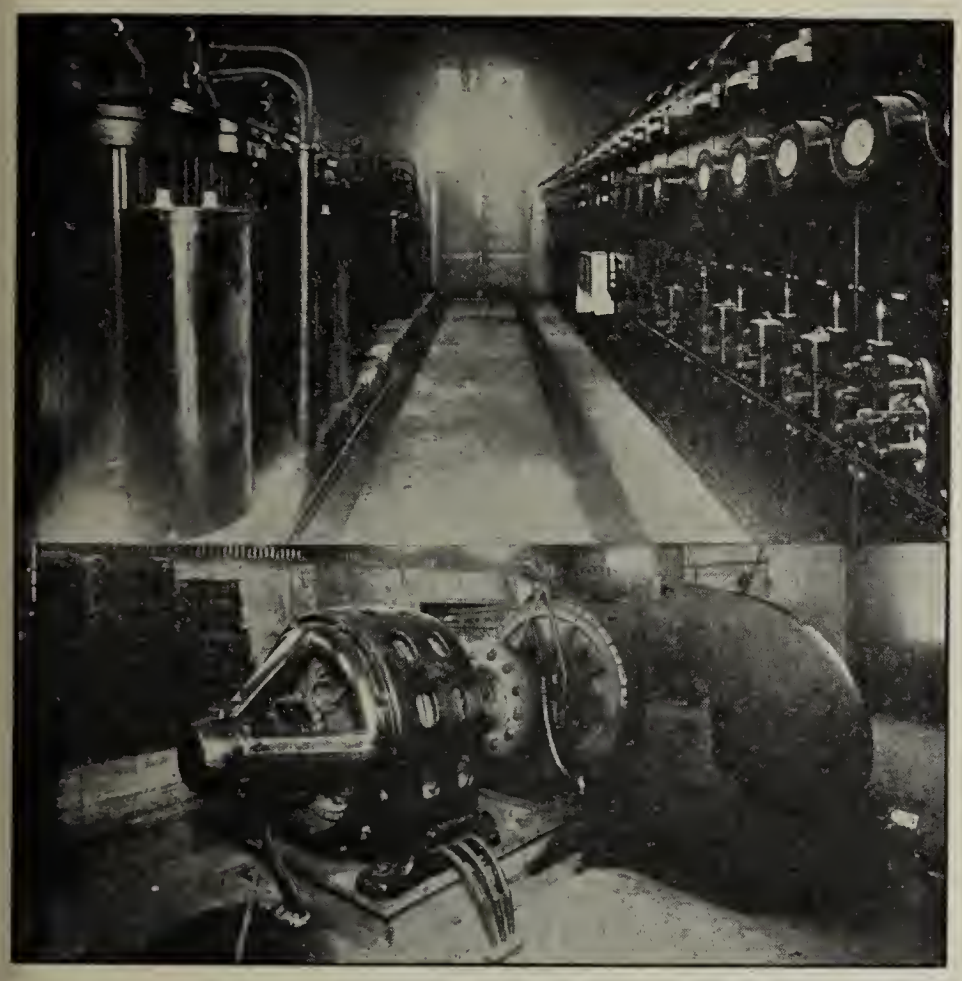
Drills. Compressed air is perhaps one of the largest individual items of power cost around a quarry and every effort is being made to cut down the necessary amount of compressed air. Where possible the use of small portable compressor outfits located out in the quarry is recommended. This practice eliminates long lines of piping with the attendant leaks and losses.

The use of deep-well electric-drilling outfits for blast-hole purposes has been making rapid strides for the last three years, and it is generally conceded that they effect great economy in power, labor and dynamite. One of the biggest savings incident to the use of these outfits is the fact that comparatively few blasts are necessary and it is consequently not necessary to tear up and re-lay stone-car tracks as often as it is when all drilling is done with standard tripod drills.

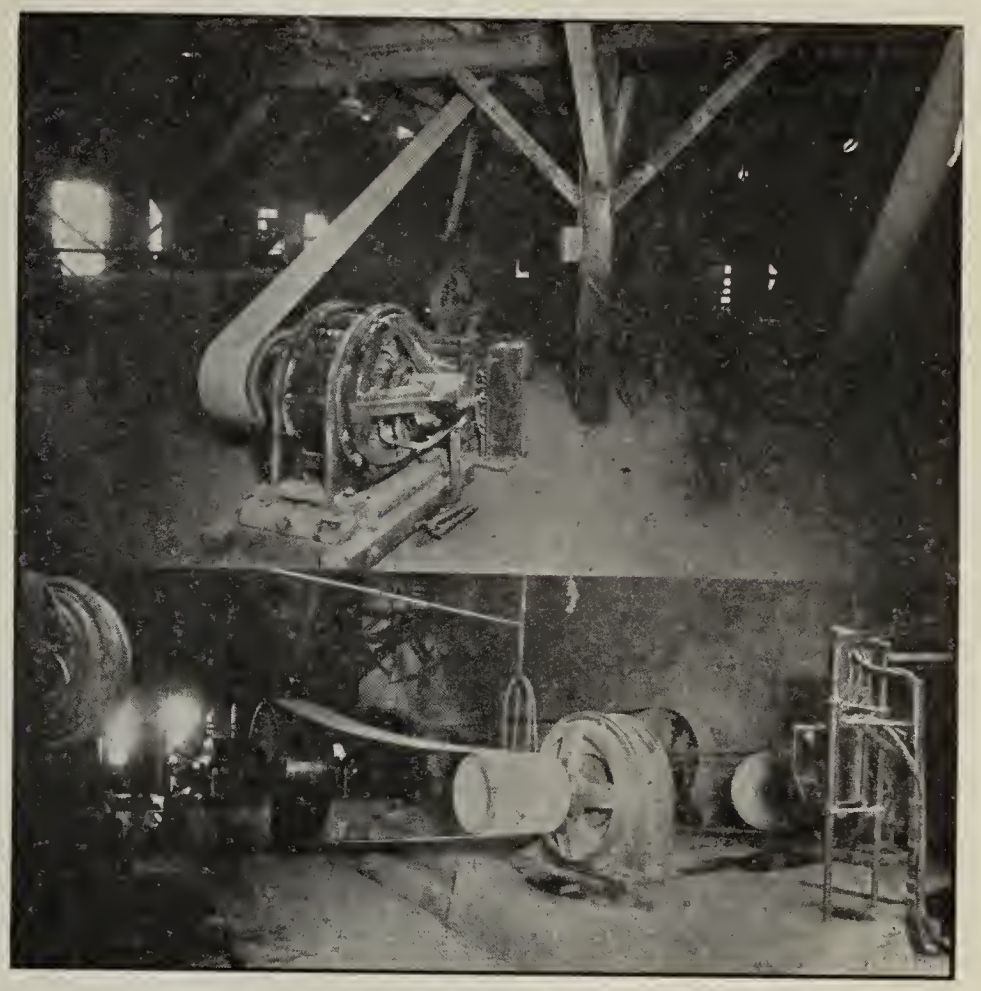
Another form of drilling is also becoming popular on account of the general tendency of the stone quarries to adopt central-station service and the higher power efficiency of the new method of drilling. The new method in question is the adoption of "pulsator" drills as manufactured by the Ingersoll-Rand Company. The standard tripod drill requires about 100 cubic feet of air per minute when operated by compressed air, which requires about 30 horsepower at the air compressor. In all probability there is, in the average quarry, a leakage from the air mains of at least 30 per cent of the total quantity of air compressed. This leakage is a constant factor and will bring the power charge against each air drill up to 30 horsepower intermittent load, plus 10 horsepower constant load over the ten-hour day. The pulsator drills are equipped with 7.5-horsepower motors, it requiring something over five horsepower to start the drills and about four horsepower running load while they are in operation; also, there is no loss of power when they are shut down.

Power Requirements.

The following data relative to power requirements of the various machines used in stone quarries may be of value to central-station engineers figuring on quarry installations.



Top View Shows Substation in Dolese & Shepard Crushed Stone Plant. Bottom View—Motor-Driven Skip Hoist.



Top View—Motor Driving Conveyors in Plant of A. C. O'Laughlin Crushed Stone Co., Belvidere, Ill. Bottom View—Motor-Driven Air Compressor.

GATES GYRATORY CRUSHER.

No.	H. P. Required.
4	14- 21
5	22- 30
6	28- 45
7½	50- 75
8	70-110
9	100-150

AUSTIN GYRATORY CRUSHER.

No.	H. P. Required.
0	4- 5
1	8- 10
2	12- 15
3	20- 25
4	25- 30
5	30- 50
6	40- 60
7½	75-125
8	100-150

AUSTIN JAW CRUSHER.

No.	H. P. Required.
2½	10
3	12
4	18

BLAKE ROCK CRUSHER.

Jaw Opening.	H. P. Required.
10 by 4	4
15 by 9	10
24 by 12	20
30 by 24	65

STEEL ROCK BREAKERS.

Jaw Opening.	H. P. Required.
7.5 by 13	12
9 by 15	15
10.5 by 22	20-25
11 by 26	25

WILLIAMS CRUSHER.

1	30
2	40
3	60
4	80
5	100
6	150
8	300

M'CULLY CRUSHER.

No.	H. P. Required.
1	4- 6
2	6- 10
3	10- 15
4	12- 20
5	20- 25
6	25- 40
7½	45- 70
8	65-100
9	100-140
10	125-175
12	200-250

Electric power shovels have been used in a number of stone quarries and at present several manufacturers are working on new designs.

ELECTRIC POWER SHOVELS.

Weight of Shovels— Tons.	Size of Dipper, Cu. Yds	H. P. Required Hoist.	Thrust.	Swing.
30	1	50	30	30
35	1.25	50	30	30
35	1.25	60	30	30
35	1.25	75	35	35
42	1.52	75	30	30
65	2	100	35	35
95	3.33	150	50	50
100	4	200	80	80

Massive McCully Crusher Receiving Stone from Electrically Operated Car. The Car and Crusher are so Controlled that no Attention is Necessary.

SYMONS CRUSHER.

No.	H. P. Required.
6	18-25
5	22-30
7½	50-75
9	100-150

Stone-Quarry and Gravel-Pit Data—Sheet No. 1.

The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.

United States Crushed Stone Company, McCook, Ill. Crushed stone and cement. Group and individual drive. Running hours per week varies with season.

Total connected horsepower, 2,189; total number of motors installed, 26; average kilowatt-hour consumption per month, 98,433.

Load-factor, 8.2 per cent.

Kilowatt-hour consumption per month for 12 months: February, 86,300; March, 123,000; April, 101,700; May, 119,900; June, 134,400; July, 110,200; August, 112,100; September, 120,000; October, 127,100; November, 86,100; December, 14,200; January, 16,200.

The average electrical energy consumption per cubic yard of output is 1.66 kilowatt-hours.

Motor Installation

The following is a list of the motors installed, with their respective drives. All motors are polyphase induction machines operating at 440 volts.

No.	Horsepower	Speed R.P.M.	Application
2	10	1,200	Slip-ring motors operating two well drills.
1	150	600	Belted to two-stage Ingersoll-Rand air compressor
1	200	600	Belted to No. 8 plant.
1	10	600	Belted to No. 12 skip-tower feed rolls. This motor is controlled by a remote-control compensator.
1	30	900	Squirrel-cage motor driving No. 14 primary screen
1	40	900	Slip-ring motor driving No. 6 crusher.
1	20	900	Slip-ring motor driving No. 4 crusher.
1	85	720	Belted to No. 9 conveyor and screens.
1	15	600	Belted to No. 20 pan conveyor.
1	10	600	Belted to No. 11 skip-tower feed rolls. This motor is controlled by a remote-control compensator
1	30	900	Belted to No. 13 primary screen.
1	40	900	Slip-ring motor driving No. 6 crusher.
1	20	900	Slip-ring motor driving No. 4 crusher.
1	300	600	Slip-ring motor driving No. 10 skip hoist.
1	300	600	Slip-ring motor driving No. 7 quarry hoist.
1	15	720	Driving No. 3 upper feed roll.
1	15	720	Driving No. 4 tower feed roll.
1	2	1,300	Direct-connected to No. 6 oil pump.
1	52	720	Driving No. 9 auxiliary hoist.
1	200	514	Driving No. 2 plain roll.
1	250	514	Driving No. 1 slugger roll.
1	300	600	Driving No. 8 quarry hoist.
1	75	600	Driving centrifugal pump.
1	25	1,200	Direct-conneced to four-inch three-stage fire pump.

Energy for this installation is supplied by the Sanitary District of Chicago.

Fort Smith Stone Quarry, Fort Smith, Ark. Crushed stone. Combination drive. Running hours per week, 60.

Total connected horsepower, 100; total number of motors installed, 3; average kilowatt-hours per month, 3,785; average kilowatt-hours per month per connected horsepower, 38.

Load-factor, 8 per cent; operating-time load-factor, 14.5 per cent.

Kilowatt-hours per month for 11 months: January, 1,200; February, 1,560; March, 2,040; April, 3,800; May, 5,480; June, 5,360; July, 4,760; August, 5,400; September 6,080; October, 3,680; November, 2,280.

Motor Installation

The following is the motor installation at this plant. The supply source is two-phase, 60 cycles, 220 volts.

No.	Horsepower	Speed R.P.M.	Application
1	50	900	Belted to a line shaft driving one Allis-Chalmers No. 4 gyratory crusher; one 60-foot bucket conveyor; one four-section four-foot screen; and one elevated link-chain tramway.
1	25	900	Belted direct to Allis-Chalmers No. 2 gyratory crusher.
1	25	900	Belted direct to six-inch centrifugal pump.

Energy is supplied by the Fort Smith Light & Traction Company.

Stone-Quarry and Gravel-Pit Data—Sheet No. 2.

Stone Crusher Plant, located in Pennsylvania. Name withheld by request. Group and individual drive. Running hours per week, 60.

Total connected horsepower, 217; number of moto s installed, 5; average kilowatt-hours per month, 3,371. Load-factor, 3 per cent; operating-time load-factor, 6 per cent.

Kilowatt-hour consumption per month for 8 months: October, 5,540; November, 4,950; December, 1,290; March, 3,590; April, 4,250; May, 2,620; June, 2,670; July, 2,060.

The energy consumption per ton of rock crushed is 0.34 kilowatt-hour.

Motor Installation

The following is a list of the motors installed, with their respective drives. The supply source is two-phase, 60 cycles, 220 volts, and 600 volts direct current.

No.	Horsepower	Speed R.P.M.	Application
1	75	850	Squirrel-cage motor belted to a No. 6 Gates, style "K" stone crusher.
1	100	850	Squirrel-cage motor belted to a 12.25-inch by 18.25-inch by 12-inch stroke, Ingersoll-Rand air compressor, running at 180 revolutions per minute and supplying air at 90 pounds pressure to the drills.
1	10	690	Belted to a 10-foot two-hanger line shaft driving one 12-foot by 3-foot revolving screen, running at 19 revolutions per minute and one 16-inch by 10-inch by 8-inch bucket elevator. 50 feet high.
2	16	...	Series-wound motors operating a 10-ton Baldwin-Westing-House locomotive used to haul five empty cars weighing one ton each up a two-mile five-per-cent grade.

Butler Brothers, Randolph, Minn. Gravel. Individual drive. Running hours per week, 60.

Total connected horsepower, 300; total number of motors installed, 6; average kilowatt-hours per month, 19,450; average kilowatt-hours per month per connected horsepower, 64.

Load-factor, 14 per cent; operating-time load-factor, 25 per cent.

Kilowatt-hour consumption per month for four months: July ,20,500; August, 19,300; September, 22,500; October, 15,500.

Motor Installation

The following is a list of the motors installed, with their respective drives. All motors are three-phase, 60-cycle, 220-volt machines.

No.	Horsepower	Application
1	75	Belted to belt conveyor.
1	20	Belted to belt conveyor.
1	25	Belted to belt conveyor.
1	100	Direct-connected to one seven-inch rotary pump with 12-inch suction; used for pumping water from pits.
1	75	Belted to No. 5 gravel crusher made by Austin Manufacturing Company.
1	5	Belted to line shaft driving one drill press; one 12-inch lathe, one emery wheel and one hack saw.

Energy for this installation is supplied by the Consumers Power Company.

Stone Crushing plant. Name withheld. This plant quarries and crushes stone of two kinds, a soft grade of cement rock, and buckwheat stone containing considerable lime. The quarrying is done mostly by hand. Horse cars are employed to convey stone from the quarry to the crushers. There are 40 men employed, working 10 hours per day. Group drive.

The maximum capacity of this plant is 6,000 tons per month; average output, 4,000 tons.

Total connected horsepower, 67.5; total number of motors installed, 4; average kilowatt-hours per month, 3,311.

Load-factor, 7.7 per cent; operating-time load-factor, 28.8 per cent.

The electrical energy consumption per ton of stone crushed is 0.75 kilowatt-hours.

Kilowatt-hours for 10 months: April, 1,020; May, 3,120; June, 4,380; July, 3,690; August, 5,370; September, 3,420; October, 3,930; November, 5,010; December, 660; January, 2,520.

Motor Installation

The following is a list of the motors installed at this plant with their respective drives. All motors are of the squirrel-cage induction type.

No.	Horsepower	Speed R.P.M.	Application
1	40	1,140	Belted to a Power & Mining Machinery Company No. 4 McCully gyratory crusher, capacity 20 to 40 tons per hour. Pulley 28 by 12 inches. From driving shaft of above machine a belt runs to a drum mechanism which draws a 700-pound car up a 100-foot incline, five-per-cent grade. Maximum load of car, 2,400 pounds; average load, 1,200 pounds.
1	15	1,120	Belted to a three-hanger shaft and a two-hanger countershaft, latter bevel-geared to lower end of a revolving screen, 15 feet long by 2 feet 4 inches diameter. Revolves at 32 revolutions per minute. Geared from above three-hanger shaft is a 12-inch bucket elevator, 65-foot lift.
1	5	1,130	Belted to a short shaft driving a 20-inch horizontal belt conveyor about 35 feet long. Belt designed to move in either direction.
1	7.5	1,140	Belted to a two-hanger shaft then geared to driving shaft at top of a 14-inch belt conveyor, having a 30-degree rise for 75 feet.

Typical Installations.

The quarry of the A. C. O'Laughlin Stone Company at Belvidere, Ill., may be considered a typical average-size plant. This company was the first in the Chicago territory to adopt electric drive throughout, having had same in operation now for over four years. The company was not only a pioneer in the use of electric power, but was also among the first to make use of deep-well drilling machines for drilling blast holes, making same electrically driven and replacing several air-driven tripod drills.

The nominal capacity of this plant is 1,000 yards of crushed rock per day, but with the electric drive it can, when necessary, increase this output by 25 per cent. The company keeps very close records of its costs, the general office having general reports from the quarry of rock output and electrical consumption which are checked against each other and the quarry has to answer promptly for any unusual procedure in the day's operation, which is very quickly shown by the relation of the rock output to the total consumption of power. The kilowatt-hour consumption of electric power at this plant averages about 1.75 per cubic yard of rock output, this figure including electric power necessary for deep-well drilling outfits, hoisting equipment for bringing cars out of quarry (quarry being about 100 feet deep), all crushing and screening processes, and operating centrifugal pumps which pump about 400 gallons per minute out of the quarry for from 10 to 20 hours per day.

One of the large electrically equipped stone quarries in the Chicago territory and one which is of exceptional interest is that of Dolese & Shepard, located near Gary, Ill. The company owns at the site a tract of land covering about 350 acres, 135 acres of which are available for quarrying purposes.

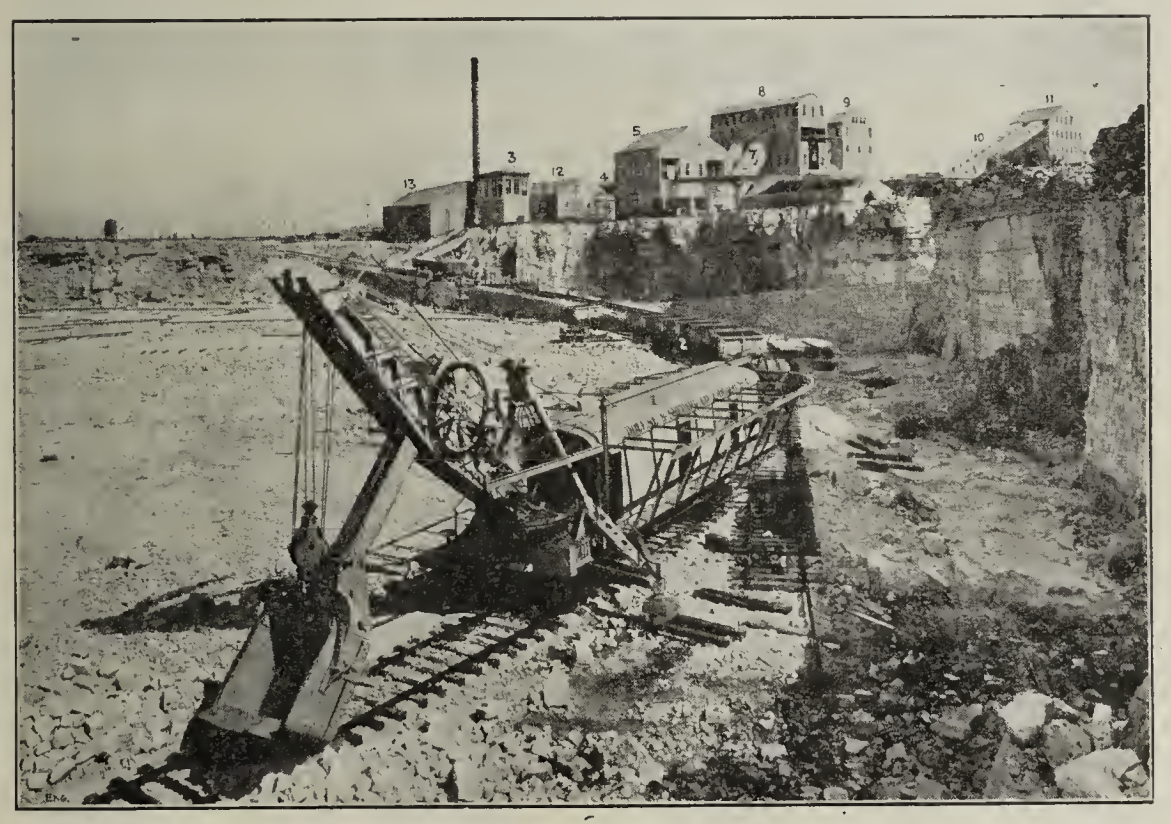
substation. The other buildings in the order in which they are located are designated as follows: Receiving crusher building; No. 9 and No. 6 buildings; the main screening building and the re-crushing building. The output of the quarry is delivered to the receiving crusher building, and then is passed continuously through the remaining buildings to the loading point for shipment.

The entire mechanical equipment of this plant is driven by electricity. All large machines are driven by individual motors, and the smaller machines are group-driven from line shafts belted to motors.

Power is purchased from the Public Service Company of Northern Illinois. In addition to the feeder from this company, there is also a circuit connnecting the plant with the Fisk Street station of the Commonwealth Edison Company of Chicago, so that in the event of a breakdown on the former line, which comes from Joliet, power may be received from Chicago. Sixty-cycle, three-phase energy is received at a pressure of 33,000 volts at the sub-station of the plant and is passed through two 750-kilowatt step-down transformers, which reduce the pressure to 440 volts for local distribution.

Energy is delivered from the sub-station to the different buildings by means of three-conductor, lead-covered cables placed in vitrified ducts laid underground the full length of the plant. Manholes are placed at each section of the latter so that branch connections may be made to distributing cabinets within the building. From these cabinets a separate supply feeder delivers power to each motor.

The plant is lighted throughout by arc and incandescent lamps, the current for lighting being stepped down by transformers in each building from 440 to 120 volts. Arc lamps are provided about the grounds and in the quarry, in order that operations may be



View of the Gary, Ill., Plant of the Dolese & Shepard Crushed Stone Co., Showing Steam Shovels, Electrically Operated Dump Cars, Etc.

The output of this plant varies in size from particles which go through a screen with 100 meshes to the square inch to stones four inches in size. The former are used as a substitute for stone and the latter shipped directly to the steel works in the vicinity for use as flux in blast furnaces.

The crushing plant includes seven main buildings located in a row. The quarry from which the stone is mined is located directly north of the plant. Starting at this point the first building in the row is the

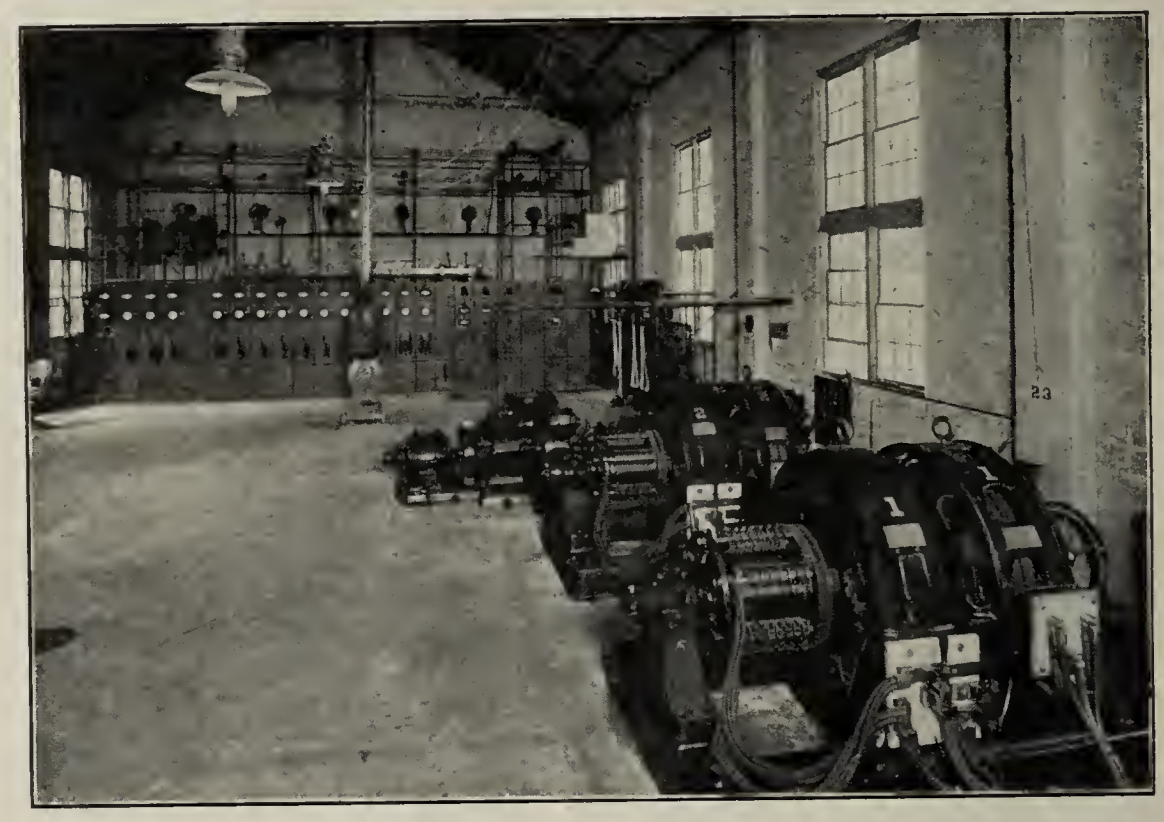
carried on at night. These lamps are supplied with current direct from the substation and are entirely separate from the lighting circuits.

The first process in the operation of the plant is to loosen the stone around the quarry. This is accomplished by drilling holes in the rock by means of automatic-feed Ingersoll-Rand rock drills mounted on rectangular frames, and arranged to be moved as a unit. The drills are operated by compressed-air motors mounted on the frame. The two compressors

each have a capacity of 2,200 cubic feet of free air per minute delivered at a pressure of 80 pounds. Each compressor is belted to a 300-horsepower induction motor. These compressors deliver to a receiver tank located in the substation, from which a supply pipe is laid on the surface in a loop extending entirely around the edge of the quarry. This pipe line is arranged in sections and provided with necessary valves, so that branch lines may be extended to points where drilling operations are in progress.

Stone loosened by the process of drilling and dynamiting is loaded into cars by steam-operated power shovels.

For conveying stone from the quarry to the receiving crusher building an electric traction system is installed, operated on the Woodford system of central



Electric Station Where Current is Controlled for Use Throughout Plant and for Lighting Buildings, Quarry and Railroad Yards.

control, which is one of the most important and interesting features of the entire installation. This is an industrial haulage system, consisting of electrically driven cars operated from an ordinary track and controlled from a central point.

At the plant of the Dolese & Shepard Company a double track of standard gauge is laid on the quarry bed, extending around its entire periphery and having cross-over tracks at intervals. The inner track, or that farthest from the sides of the quarry, is considered the main track, and the other the loading track. At the end of the quarry nearest the crushing plant a track leading off from the main one leaves the lower level and extends up a six-per-cent grade to the surface, where it turns to the right on a three-per-cent grade and extends further up a six-per-cent grade and on a steel trestle to the crushing plant. The total elevation above the lower level of the present quarry is about 80 feet. On its approach to the crushing plant the track divides, a branch running on each side of the crusher and uniting again into one track on the opposite side of the plant, extending down an eight-per-cent grade, curving to the right and connecting with the main track at the lower level. The track on the incline to the crusher and back forms half of a figure eight, the other half being completed by a track on the lower level, the one on the six-per-cent grade crossing that on the eight-per-cent grade, making the entire track circuit free for a continuous cycle of operations.

The cars of this system for handling the stone are of the side-dump type, of ten-yards capacity each, built entirely of steel, except the box, which is steel-lined. Each car is equipped with 30-horsepower street-railway motors and also with an automatic controlling mechanism for this system of control. Each car is also equipped with an electric brake under the control of the central operator. Included in the automatic controlling mechanism on the cars is a selective relay; which, upon the forward movement of the controlling lever in the tower, places itself in such a position as to close the motor circuit. Upon the opposite movement of the lever this relay closes the brake circuit, causing the brakes to operate.

Electric current is conducted to the motors and controlling mechanism by means of a third rail, divided into sections, which is mounted between the track rails. This location of the third rail is particularly adapted for tracks which are necessarily portable.

The controlling tower from which all the cars in the system are manipulated is located near the crusher and in sight of a large portion of the quarry bed, where the circuit of main and loading tracks is located. From this tower each car may be operated independently from any of the others. It is possible to start it in either direction or to stop it with a brake upon any portion of the system of tracks over which it is being operated. The switches of the cross-over tracks are operated from the controlling tower, so that the operator may dispose of the car on either the main track or the loading track at will.

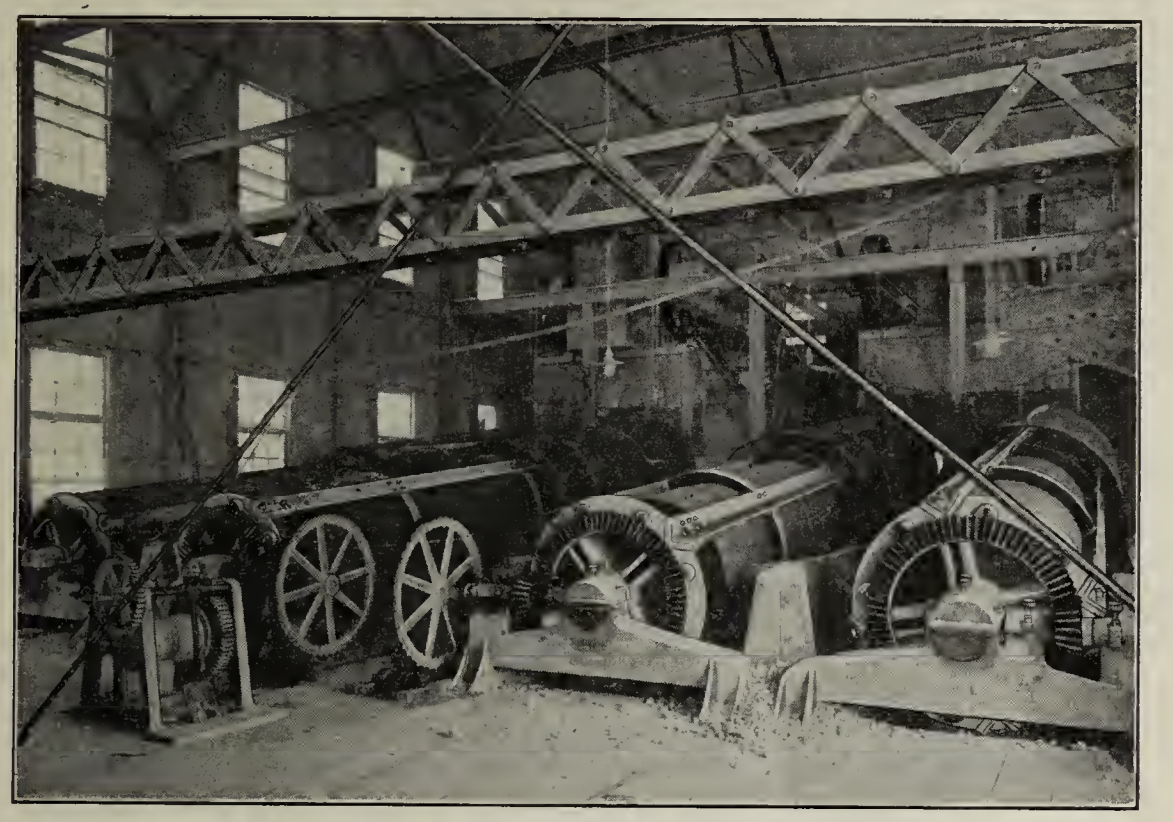
After the car is loaded it is unnecessary for the operator to pay any attention to it on its trip out of the quarry, up the grade, and to that portion of the track approaching the crusher, as it here runs on a level track through the building and stops without his attention.

The section of the track in the crusher building is under the control of the operator stationed in the latter. When a load is needed at the crusher it is brought forward by this operator, electrically dumped and started on the downward trip.

The speed of each car on this downward trip from the crusher to the quarry is governed automatically. As each car approaches the downward grade it comes in contact with a stationary trip which automatically

operates a lever extending out from the side of the car. The lever operates a switch which changes the connection, causing the motor to operate as a generator. The current thus generated passes through a resistance mounted on the car, which limits the speed. It may be seen that this speed can either be increased or decreased, according to the amount of resistance inserted.

The level portion of the track leading to the crusher and which divides into two branches extending on each side of it, has a capacity for a number of loaded cars. As these loads may be kept close together, and with the opportunity to dump them on each side of the crusher, it will be seen that the amount of raw material that can be delivered to the crusher is limited only by the number of cars in operation and the facilities for loading them.



Corner of the Screening Building Where the Crushed Rock is Received from the Quarry and Given to Proper Grade.

The control of the cars is resolved into starting them from the shovels, and bringing them forward at the crusher to be dumped, and starting them upon their downward trip. While in an emergency the car may be started or stopped upon any portion of the track, the operation of each car is continuous and does not require the attention of the operator except at the terminals. A car loaded at any of the shovels will be 1,000 feet or more on its way by the time the next car is loaded at the same shovel, making it possible for empty cars and loaded cars to be operated along the main track and distributed to and from the different shovels as they are needed.

An automatic scale is installed along the route of the loaded car track which weighs each load as it passes over. Each car, by a non-interfering signaling device, indicates at the scale by which shovel the car being weighed was loaded. The weight of the load and the number of the shovel loading it is automatically marked on the tape at the same time. The tonnage of each shovel for the day may in this way be recorded at the scale.

Direct current at a pressure of 250 volts for the operation of the car and track system is furnished by two 200-kilowatt motor-generator sets.

The receiving crusher to which the quarry cars deliver in the first building is of the McCully gyratory type with receiving openings 42 inches in width. This crusher is called the "Mammoth," as it is believed to be the largest of any type that has been built to date and breaks the stone to a size of eight inches and under. Its approximate weight is 213 tons, and it has an estimated capacity of 800 cubic yards of stone per hour. For operating, it is connected by means of a steel rope drive to a 250-horsepower induction motor.

This crusher has two discharge openings, one on each side, which deliver stone into pan conveyors 54 inches wide. These conveyors extend up into the top of the No. 9 crusher building at an angle of 45 degrees. Each conveyor is driven at the upper end through gearing by means of a 75-horsepower induction motor.

These conveyors both discharge at the top into two No. 9 gyratory crushers, which are each belt-driven by an individual 100-horsepower induction motor. The stone is reduced in these crushers to pieces having a maximum size of four inches, and is discharged through each crusher into two 48-inch by 24-foot revolving screens, having two-and-one-half-inch perforations. The stone passing each of these four screens drops into a hopper supplying a 24-inch horizontal belt conveyor. These four conveyors are placed in concrete-lined trenches and extend from this building to and through the adjoining No. 6 crusher building, where they discharge the stone at the bases of four 30-inch belt conveyors leading to the main screening plant. The over-size from each of the screens to which the output of the No. 9 crushers also is delivered, falls into a 48-inch pan conveyor similar to the one in the receiving crusher building, which elevates the stone from these screens at an angle of 45 degrees and discharges it into storage bins of the No. 6 crusher building.

In buildings on each side of these bins there are installed four No. 6 gyratory crushers, which reduce this stone to about three inches in size and discharge it into 24-inch belt conveyors that extend from the No. 9 building to the 30-inch conveyors leading to the main screening plant. These crushers are operated by 50-horsepower induction motors.

Four 30-inch belt conveyors geared to 60-horsepower induction motors convey the stone to the main screening building, where it is discharged in the revolving screens. The stone is here distributed, according to size, to the main storage bins.

The recrushing plant is equipped to reduce the size of any stone, suitable conveyors and crushers being

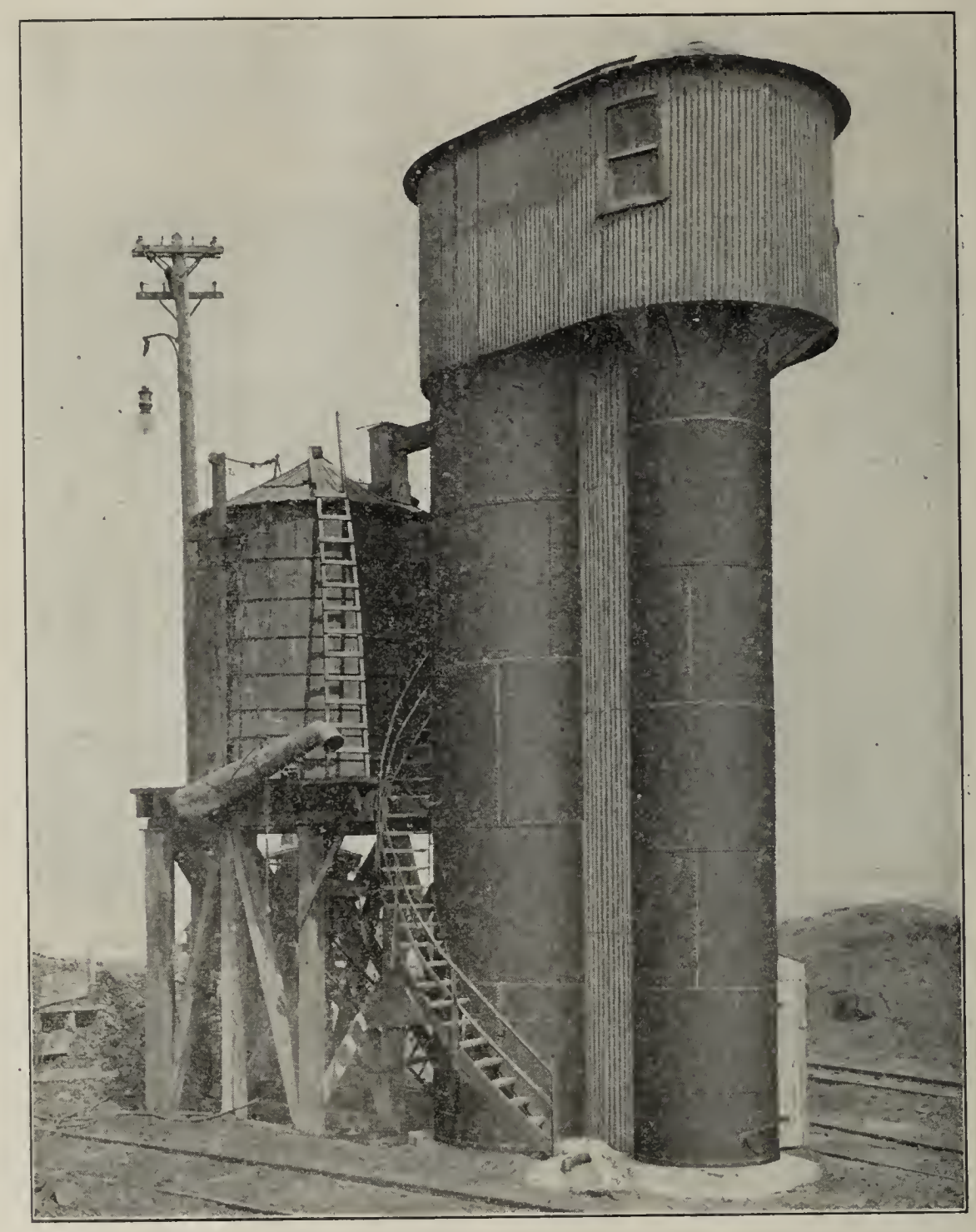
provided. All the crushers and conveying machinery are driven by individual motors. The average electrical energy consumption per cubic yard of stone produced, at this plant, is 1.2 kilowatt-hours.

Another interesting installation is that at the quarry of the United States Crushed Stone Company, located at McCook, Ill. This plant is operated night and day and turns out an average of 6,000 tons of crushed stone per 24 hours. Electrical energy is purchased from the Sanitary District of Chicago. Sixty-cycle, three-phase energy at a pressure of 12,000 volts is received at the quarry substation and stepped down to 440 volts for power and 120 volts for arc and incandescent lighting.

An interesting feature of the electrical installation at this plant is the application of motor-driven drills. The company has installed two of these, known as blast-hole drills, which have given such satisfaction that additional ones have been ordered to entirely replace the air drills. A view of two of these drills is shown in one of the accompanying illustrations. The drill consists of a 10-horsepower motor belt connected to a shaft operating a walking beam, which alternately raises and lowers the bit of the drill. The drill bores a hole six inches in diameter and 50 feet deep.

It is stated by the officials of the United States Crushed Stone Company that three of these drills are equal to ten of the compressed air type in the matter of work, and cost about one-seventh as much to operate.

At this plant stone from the quarry is hauled to the crusher house in skip cars propelled by steam locomotives. When the cars arrive at the foot of the incline leading to the receiving crusher they are hoisted by means of a 300-horsepower skip hoist. After the stone has passed through the rolls and been crushed it drops into a lower hopper and from there is loaded on a retarding roll and into two deep skip cars of 15-ton capacity each. These cars are run up a steel skipway 210 feet long and built on an incline of 45 degrees. The electric hoist which handles these cars is also of 300-horsepower capacity. A detailed description of the motor equipment is given in the accompanying data sheets.



Dodge Eureka Water Softener at the Plant of the Dolese & Shepard Crushed Stone Co., Supplying a Long Felt Want and Plenty of Treated Fluid for the Yard Locomotives and Steam Shovels.

The Exeter Machine Works, Pittston, Pa., is installing a large coal and ash-handling plant at the power plant of the American Sugar Refining Co., Brooklyn, N. Y. When completed, this system will take care of all operations from the time it unloads the coal from ships at the dock by means of conveyors until the ashes are removed.

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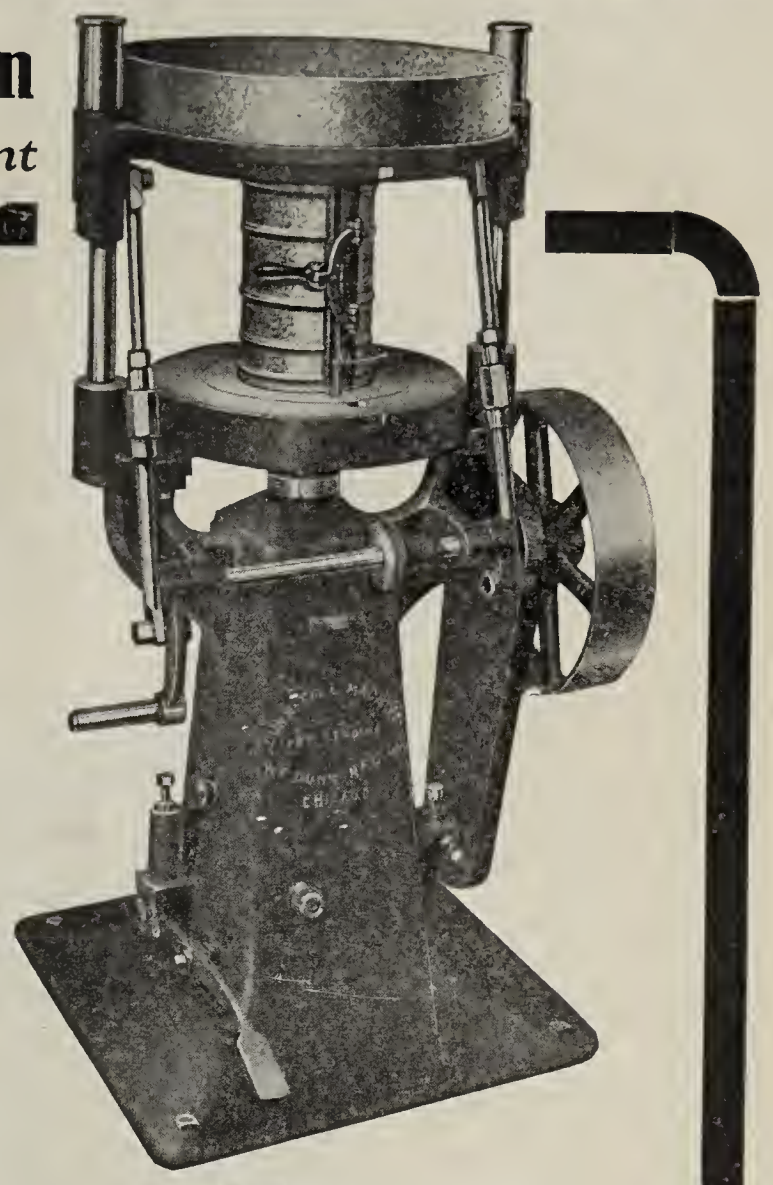

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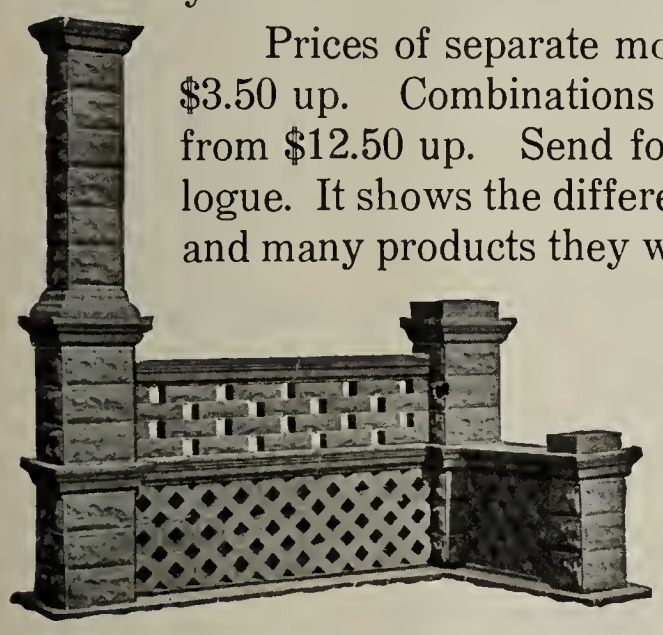

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Stone Crushing Plant of the Chicago Union Lime Works

The quarries of the Chicago Union Lime Works are within the city limits of Chicago, though when the quarry was opened in 1859 the region was open country. Three years ago a modern plant, as illustrated in the following views, was designed and built by J. C. Buckbee & Co., engineers of Chicago.

The plant as a whole is located at the side of the quarry. The quarry level being 250 feet below the street level, elevators are used for lifting quarry cars to the crusher floor level about 30 feet above the street. Here the cars are dumped into a gyratory crusher from which two bucket elevators raise the crushed stone to the head of the screening plant, which is housed within a galvanized steel enclosure at the top of the structure. The crusher and elevator system is housed within the building at the rear; while the concrete walled structure at the front comprises the bins with a total capacity of 1,500 cubic yards. The screening plant is directly over the bins, making it possible to chute the various sizes into their proper bins. For recrushing to smaller sizes two additional crushers and two sets of crushing rolls are installed. These are fed by conveyors running underneath the storage bins. The product of these crushers is again elevated by the system first mentioned.

The main structure is supported on sixteen rectangular reinforced concrete columns, the outer columns being 3½x1½ feet and others 3x2 feet in size. The bin walls are concrete slabs 10 and 12 inches thick, heavily reinforced. The bins are 25 feet deep and 12 feet wide and cover the entire area of the main structure.

Though corrugated sheet steel has been used as a wall material for the superstructure and part of the elevating plant, yet all loads are carried on reinforced concrete structural beams, steel being used only as a reinforcing and as the exterior wall.

The comparative costs of crusher plant costs in timber, steel and concrete are respectively: Timber, 100; steel, 200; concrete, 150.

Considering the freedom from depreciation of concrete and its moderate increase in cost over timber there is little question of the economy of concrete for this class of structure. So satisfactory has this plant proven to the owners that they have retained the same engineers to duplicate this plant in the immediate vicinity, to a total capacity of 5,000 yards storage. The capacity of the single plant now in use is about 1,500 yards daily, and on account of compact and efficient arrangement the cost of crushing has been reduced to a minimum.

One of the interesting features of the plant is a circular stairway which takes the place of a steel stair in the original design. This is supported on a 6-inch steel pipe encased with 3 inches of concrete. Steps were cast one at a time, a curved under plate being used, a vertical plate for the riser and a curved outer form for the edge.

The reinforcement consisted of rods near the upper surface of the step which encircled the pipe, thus making each step a cantilever beam. The construction is interesting and shows the easy adaptability of concrete to special purposes.

Interior View of the Stone Crushing Plant of the Chicago Union Lime Works, Showing McCully Crusher, Concrete Circular Stairway, Concrete Floors and Concrete Beams. This Plant is Operated by Electricity.

AN OVERSIGHT.

We failed to give "Concrete-Cement Age" credit for the article by H. F. Porter in our last issue entitled "Consistency and Time in Mixing Concrete." This article was written expressly for "Concrete-Cement Age."

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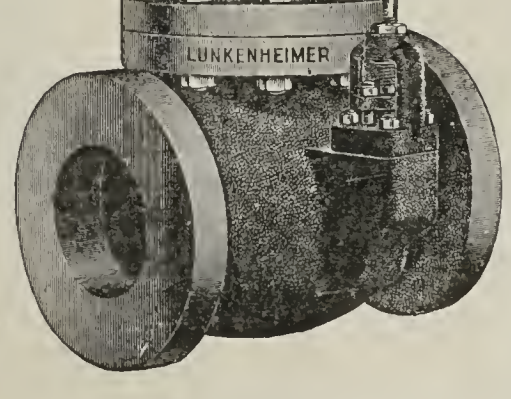

All parts of these valves subjected to wear are renewable and are made of a high grade bronze composition containing a large percentage of copper and tin. The iron used is hard and close-grained and has a tensile strength of 25,000 pounds per square inch.

Made in Medium, Heavy and Extra Heavy Patterns, guaranteed for working pressures up to 125, 175 and 250 pounds per square inch, respectively.

The line consists of Globe, Angle, Cross, Check, Gate, Non-return Safety Boiler Stop Valves, etc.

This line is also made in "Puddled" Semi-steel, suitable for superheated steam and severe service, and in Cast Steel intended for extreme conditions of pressure, superheat and service.

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-13-

Transportation of Material in Large Industrial Plants

By H. W. Arnold

During the last few years much has been written and spoken relative to efficiency in so far as the manufacturing end of the matter is concerned, but in very few instances has the transportation of material in and about manufacturing plants received the attention its importance deserves.

Necessarily, the transportation facilities of a plant include all the surface and overhead devices used in moving material from one point to another, but in this brief article it is purposed to consider only the surface movement of material.

In most instances large manufacturing plants present a rather difficult transportation problem. This is due to the unsymmetrical growth of plants of large proportions owing to the fact that in a great majority of cases the expansion was not anticipated or provided for in the original conception.

The Jeffrey Manufacturing Co., of Columbus, Ohio, is spread out over an area of approximately 26 acres and has 18 acres of floor space. This plant manufactures a large and varied line of electrical locomotives, electric storage battery trucks, coal mining, elevating and conveying machinery of all descriptions, structural steel work, etc., etc.

A bird's-eye view of the plant is shown in Bulletin No. 13B.

Throughout the shops of this company a high degree of efficiency has obtained for some time, but the matter of transportation of raw and finished material did not receive adequate consideration until a few years ago. Up to that time our raw and finished material was being transported to and from cars in and about our various shops and departments by means of two-wheeled warehouse trucks, four-wheeled trucks and industrial cars. Also, part of the territory was served by Jeffrey Storage Battery Truck working on a 36-inch gauge industrial track. A careful study of existing conditions made plain the fact that a very material saving could be effected by establishing a more efficient transportation system.

After considering the problem from every angle, it was decided that the Jeffrey Storage Battery Trucks and industrial cars offered the best and most efficient means of surface transportation. Accordingly, the industrial railway was extended to take in all departments and a systematic method of car dispatching established. The accompanying plan gives an idea of how thoroughly the different buildings are served by the industrial track.

As soon as this system was established, very rigid instructions were issued that absolutely no material was to be transported by other means than by the Storage Battery Trucks and industrial cars. It was immediately found possible to dispense with the services of a two-horse team, 28 two-wheeled warehouse trucks, 13 four-wheeled trucks, 8 wheelbarrows and 18 men whose whole time had been devoted to this purpose. This effected an annual saving of more than $600.00 per month over the cost of the former system, taking into consideration the interest and depreciation on the investment, operating, maintenance, costs, etc. The monthly tonnage handled is close to 4,000 tons. Viewed from its present efficiency, it would seem almost an utter impossibility to go back to the previous or any other method of transporting material.

The Jeffrey Storage Battery Truck is so simple in design and rugged in construction that it does not require the service of skilled operators, and the maintenance and operating costs are extremely low.

Our Bulletin No. 13B shows a number of illustrations in which these trucks are used for hauling a great variety of materials.

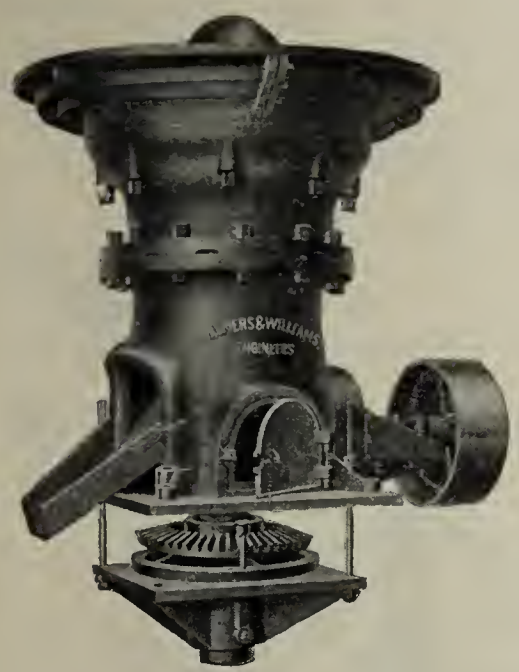
The industrial Railway Track shown on pages 4 and 5 gives a comprehensive idea of the system, and the wide range of usefulness for transporting material with the trucks.

These trucks will pay for themselves in a very short period of time, and especially where the industrial track system is already installed. The Jeffrey Mfg. Co. would gladly demonstrate to interested parties further details of the systems we employ for dispatching our trains, without loss of time, thus securing the greatest efficiency from the service of these trucks.

NORTHFIELD MIXER.

About two years ago a Western bridge builder devised a light batch concrete mixer for his own use which worked so satisfactorily that it was put on the market as the Northfield mixer by the Northfield (Minn.) Iron Co. Its use has been extended from concrete to mortar, surfacing and plaster. The Great Northern Bridge Co., of Minneapolis, recently ordered 10 of these mixers after a trial of one on two jobs under different foremen; the Fargo Bridge & Iron Co., of Fargo, N. Dak., sent in a repeat order a short time ago, and builders in Ohio have purchased a large number on rush orders, some of them directing the mixers to be sent by express, something which is not so extraordinary as it seems at first because the mixer is not heavy.

You Can Buy a Gyratory Crusher for Less than You Think



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BRONZE BALL GYRATORY CRUSHER

It has been experimented on, developed and perfected by us. It will reduce the cost of your crushed product, by reducing the amount of power consumed, by the low cost for repairs and by the increased capacity.

You cannot afford to let this opportunity go by.

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For Efficiency, Durability and low cost of Maintenance

Jeffrey Malleable and Steel Chains and Sprockets

are unequalled.

Especially adapted for handling raw materials in Cement Mills, Phosphates, Crushed Stone and other abrasive materials.

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Waterproofed with Ceresit, 36,000 pounds. One carload Ceresit used.

Ceresit Waterproofing has been put to practical test for years on every possible sort of waterproofing engineering, both large and small, and it has never failed to do its work.

Please write for Book "Q" and try Ceresit on your next job.

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CONCRETE and cement mortar can be permanently and effectively waterproofed with a treatment of CERESIT for water will not penetrate where CERESIT is. Many years of practical tests on important engineering projects have proven the water repellant properties of CERESIT.

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has been used with success on many important concrete engineering projects. Tunnels, dams, reservoirs, foundations, swimming pools, tanks, water towers, boiler pits, building walls, viaducts, aqueducts.

Regard CERESIT as the Best Waterproofing

Chester, Pa., July 17, 1911.

Mr. A. T. Schreiber, Dist. Mgr.,
1218 Chestnut St., Philadelphia.

Dear Sir: — We have used considerable CERESIT WATERPROOFING in our work at the Beacon Light Company's plant, where we were below tide water. The above-named plant is along the river front, and we checked water at a pretty high pressure. We also used it in a concrete arch bridge for Senator Sprowl on his estate. **Of all waterproofing materials that we have seen tested, CERESIT in our mind is the best.**

Yours very truly,
The Dickerson Paving & Construction Co.

CUTS LABOR AND OPERATING COSTS.

The low intake of the "Northwestern Cone Batch Mixer" saves from $60 to $100 per month in labor costs alone. The price is considerably less than other standard high grade mixers and the speed in mixing is so great that you can use a smaller size of this type with capacity per day equal to other large size machines, two features alone which will save you at least half the cost of your mixer equipment. This is the only mixer that combines the principles of cone, cube and polygon shapes with the inside shifting and scattering of materials by paddles and scoops, adjustable for wet and dry mixes and all kinds of work. The paddles are attached to rods instead of the shell, a self-cleaning machine with no pockets for cement to collect in. The low waist-high intake allows several men to charge by shoveling, or to fill with wheelbarrows from a 28-inch platform. Intake is open showing mix at all times; slopping eliminated. Discharging device shoots any quantity from shovel to cartload into the highest wheelbarrows or directly into molds. Mixes a batch in 20 to 30 seconds. Built in all sizes from 7 feet up—steam, gasoline or electric motor power.

The 1912 Wholesale Catalogs of Mixers and Concrete Machinery issued by the Northwestern Steel and Iron Works, 1080 Spring st., Eau Claire, Wis., is now ready. These catalogs show and describe in detail the full line of Northwestern Mixers—Sidewalk, Contractor's Block Plant Mixers, Continuous Mixers, Elevators, Hand Mixers, etc., and Complete Line of Concrete Machinery of every description. State what you are interested in and get the catalog covering the subject.

At the annual meeting of the Saginaw Sandstone Brick Co., Saginaw, Mich., held the latter part of January, it was decided to raise the capital stock from $25,000 to $50,000, and additions to the plant will be made which will increase the daily capacity from 25,000 to 50,000 brick. The former officers and directors were re-elected as follows: President, J. L. Jackson; vice-president, C. C. Remer; secretary, S. S. Roby; treasurer, E. D. Church, and general manager, John C. Reinke.

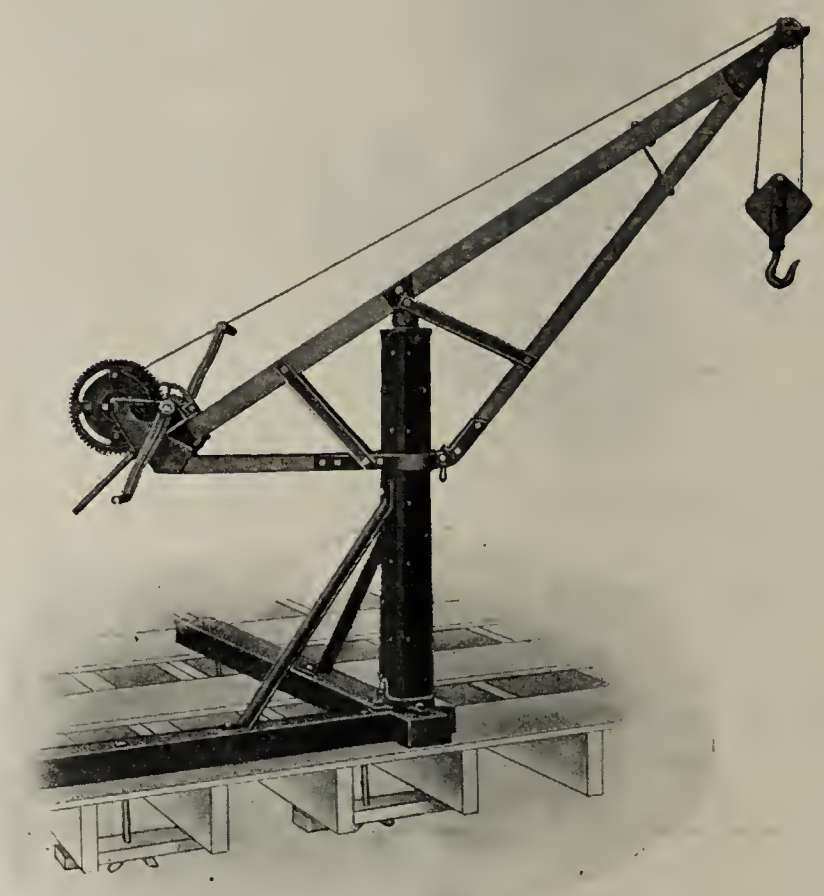
SPECIAL LINE OF DERRICKS.

A line of builders' derricks that deserves the special attention of Cement & Engineering News readers is being offered by Sasgen Brothers, 2053-57 Racine avenue, Chicago, Ill.

The Sasgen Reinforced Circle swing builder's derrick shown below is without question one of the most practical hand power derricks made for building and structural work, loading and unloading cars and wagons from platforms, well digging and various other purposes. It can hoist 300 feet. The fittings on this machine are all crucible steel and malleable, including the geared winch, which makes the derrick safe and durable. They can make this derrick if so desired to be used by hand or power for an additional $3.00. It is 8 feet in height, weighs 350 lbs. and has a circle swing of 10 feet. It is equipped with 150 feet of cable. swivel block, fasteners, band brake for load, boom brake to keep boom from swinging when hoisting. It has a hoisting capacity of 2,500 lbs.

The Sasgen pole derrick is extensively used by builders for setting posts, girders, joists, stone coping, etc. This derrick weighs about 200 pounds, is equipped with winch, 100 feet of cable and block. It is made of 5½x5½ selected Norway, provided with extension sheave frame. The fittings are of best malleable castings.

The improved setter derrick is another product of this company. The top frame of this derrick is made of the best malleable iron, is equipped with two sheaves, which eliminates the block on top. This frame is supported by ⅝-inch truss rod and has lugs for guy lines in front and back, also clamps for fastening extension pole. The bottom and side pieces are connected with two malleable castings and fastened by means of bolts so the derrick can be easily taken apart if necessary for shipment or removal.



MANHOLE AND CATCH BASIN CURBS AND COVERS.

The Vulcan Iron Works, established in 1852, are now located in their new large 4-story factory at 327 to 340 North Irving avenue, Chicago, where they have modern up-to-date machine shops and foundry. They are sending out a very interesting and useful circular, No. 39, containing 23 pages, describing and illustrating the various styles and sizes of manhole and catch basin curbs and covers now being manufactured by

them. Their product is used by the leading contractors, engineers, telephone and electric light companies, cities, cemeteries, private estates, towns and villages throughout the country. This booklet ought to be on the desk of everyone who uses manhole and catch basin curbs and covers.

CEMENT
... AND ...
ENGINEERING NEWS

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CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY

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JOHN F. WALDRON - - - - - - - - Advertising Manager

CHICAGO, OCTOBER, 1912

PROSPERITY AHEAD.

The cement industry, like all other trades, has entered at last upon a new era of prosperity after having labored for years under over-production and keen competition which, in some localities, reduced the price of cement to figures that left very little profit to the manufacturer.

Bountiful crops and the return of confidence in general business have brought about this change. During the past years of trust prosecution, which led to a policy of procrastination in all branches of industry, trades as the manufacture of steel or cement and the mining of metals have been unable to prosper. Upon the return to normal conditions, therefore, the country has awakened to the fact that, first of all, the supplies of raw materials have to be replenished and that a great deal of repair work has to be done in all industries in order to be in a position to start upon new business. Railway companies are buying millions of tons of steel to repair their roadbeds which were neglected for a long time. Manufacturers of electrical equipment have to lay in vast supplies of copper, a staple article found to be exhausted all over the world.

This marvelous change, foreshadowing an era of unprecedented prosperity, has benefited the cement industry to such an extent that actually a cement famine exists in some parts of the country and that the price of cement has been rising constantly during the past six months.

Moreover, the use of cement is still rapidly expanding and concrete is being applied nowadays in vast quantities in cases in which it merely served experimental purposes up to a short time ago. The best example furnishes the extensive application of concrete in road building, for which purpose it is highly recommended by the advocates of road construction who have started a propaganda for the construction of "good roads" throughout the country and are having meetings and expositions in all states.

While the cement manufacturer in the East and Middle West is thus once more placed in a comfortable position and is able to foresee years of prosperity, the Pacific Coast will witness a rise in the price of cement that will assure the manufacturer of large profits for a long time to come. New plants starting up will have an easy time of it and cement propositions under consideration must necessarily become certainties in the near future in order to supply the rapidly growing demand for cement in the West.

Hence confidence, hopefulness and satisfaction have replaced the gloom that overshadowed the manufacturing industries for a number of years.

AMERICAN ROAD CONGRESS.

One of the most interesting features of the American Road Congress to be held at Atlantic City, September 30 to October 5, will be the booths in which various States will exhibit models and maps of their roads and furnish information to automobilists as to the best routes and information to road builders of other states as to the manner in which the roads shown on the maps and models were constructed.

Every state in the Union is to be furnished a booth without cost. The states of New York, New Jersey, North Carolina, South Carolina, Tennessee, Illinois and Kansas have already made definite arrangements to occupy the booths set aside for their purposes. Georgia and New Hampshire are making arrangements for booths.

The American Road Congress is being held by the American Association for Highway Improvement, the American Automobile Association, and the National Association of Road Machinery and Material Manufacturers. The United States Government will exhibit all its road models and miniature electrically operated models of road machinery and stereopticon views, and every state road department will be represented. The special booths in which the various states will exhibit their maps, models and their various publications, will place the Congress on a par with the biggest international exposition.

The Old Trails Committee of the Daughters of the American Revolution is making preparations for an exhibit showing the development from the old trails of the past to the boulevards of the present. The Committee expects to exhibit a Prairie Schooner and horse team, stage coach of the period of 1812 and an automobile of the period of 1912. There will also be a real log cabin presided over by the D. A. R.

CEMENT SEWER PIPE.

The use of cement for water mains and sewer pipe purposes is becoming more general and in order to meet the demand the Perfection Concrete Company, of Winnipeg, Man., are now turning out glazed cement sewer pipe from 4 inches to 24 inches in diameter. This plant, which was planned by Mr. A. E. Cline, superintendent, is strictly up-to-date in its layout, and is designed so as to call for the minimum of handling the material in its passage from the raw to the finished state. All material is brought to the west end of the factory by rail, where it is unloaded to the various bins. From the bins the sand, gravel, crushed stone and cement are then measured in their proper proportions. From there it is taken to a platform on the second floor by means of freight elevator, mixed, then dumped, reaching by gravity the particular machine for which it is intended. The plant is now steadily turning out glazed cement sewer pipe, the machinery for this purpose being kept busy all the time. After the pipe leaves the machine it is placed in a curing room where it stays for one day. The following day it is removed to kilns and stacked, where it remains at least a week before being shipped.

Field Inspection and Tests of Concrete

By G. H. Bayles.

In the spring of 1910 we were commissioned to design and superintend the construction of a warehouse 100x210 feet and four stories high in the Borough of Brooklyn, New York City, for the New York Dock Company. The use of reinforced concrete was recommended and adopted, but from our own experience and being familiar with the many criticisms of this material and the considerable number of failures in its use, we were of the opinion that very careful inspection should be maintained. Consequently when the work was started in the latter part of July, the engineer who designed the building was put in charge, assisted by two inspectors, both experts in the making and placing of reinforced concrete.

The engineer assumed general charge of the work. One inspector superintended the proportioning and mixing of the concrete and the other placing it in the forms. They collaborated in the inspection of constructing and wrecking forms, placing reinforcements and testing materials. There seemed to be no recognized system of testing concrete or concrete materials on the job, so a series of tests was arranged to meet, as we believed, the necessary requirements. These tests were as follows: For cement tests for fineness, constancy of volume, time of setting, initial and final, specific gravity and crushing strength of 1:2 cement mortar; for sand tests for loam, fineness and percentage of voids; for stone tests for percentage of voids; for concrete tests of crushing strength; no tests of the steel were made on the job.

A temporary laboratory was built near the work and the necessary apparatus installed. This laboratory was intended to be such as could be built on any job, and no arrangements were made for heating it except the use of a small oil stove in extreme weather. It was 12x8 feet, built of ⅞-inch sheeting on 2x4-inch frame with felt roof; one door front, and windows one side and rear.

At first six samples for testing were taken from every car of cement, but later this number was reduced to three. For the fineness tests the usual 100-mesh and 200-mesh sieves were used. The inspector shook the sieves in his hands and judged by the eye when no appreciable quantity of cement was going through. Scales graduated to milligrams were used to determine the proportions. A near-by tinsmith made the boiler and wire rack for the constancy of volume tests and the glass plates were cut on the job from scrap window glass. The boiler is 13 inches high and 8 inches in diameter, with a lid, and the rack was made to hold twelve pats at a time. The test pats were boiled for five hours or more. The Vicat needle was used to determine the time of setting. The variable temperature made the results of these tests vary so greatly as to be of little value. Le Chatelier's specific gravity apparatus was used with gasoline for making the specific gravity tests.

The test for crushing strength, not being in such general use as the other tests, requires more detailed description. It consisted in testing to failure 4-inch cubes of 1:2 cement and sand mortar. More elaborate apparatus was necessary for making these tests. For this purpose were required molds for 4-inch cubes, a damp closet large enough to hold four gang molds, pans of water in which to submerge the test specimens, and a compression testing machine. The gang molds were made of 1-inch lumber, held together by iron clamps. The measurements were not exact, but the surface areas were approximately correct within the limits of accuracy of the tests. While only two cubes were used for each test, the gang molds were made for four cubes, as the same molds were to be used for the concrete tests. They were made by a carpenter on the job and the clamps were made by the company's blacksmith.

The damp closet was built into the corner of the laboratory, the sides and floor of the laboratory forming two sides and the bottom of the closet; the other sides and top were of ⅞-inch tongue and groove sheeting. Two shelves were put in the closet, each large enough to hold two gang molds, and space was left below for a large pan of water. When a mold with two test specimens was placed in the closet a wet coffee sack was thrown over it, the ends of the sack dipping into the water below. A better arrangement would be to have the closet lined with felt, the lower edge of the felt dipping into the water. The simpler method was used as being one easily provided on any job.

The pans for water in which the test specimens were to be submerged were made 28x28 inches and 5 inches deep, large enough to hold thirty-six 4-inch cubes each. The same size pan was used in the damp closet. Five pans were required and they were made by one of the company's sheet-metal workers.

The selection of a compression testing machine was more difficult. Most machines designed to do this kind of work are elaborate and expensive. A simple and comparatively inexpensive machine was desired and after careful investigation a hydraulic machine was acquired, consisting essentially of two horizontal plane surfaces, one fixed, the other movable, between which the test specimens were crushed. The top surface is fixed, being held rigidly in place by two side posts extending upward from the base. The lower or movable surface is fixed rigidly on top of a 5-inch cylindrical ram with cup leather packing moving in a copper-lined cylinder. The pressure is applied by means of a hand pump and is measured on a gauge reading total tons on the 5-inch ram. The gauge is graduated from 0 to 60 tons, and while the rated capacity of the press is 50 tons, cubes were crushed which required as much as 60 tons pressure. As many of the newer cubes crushed at low pressure, and exact readings on the gauge that was furnished on the machine were difficult, a second gauge was attached reading up to 10 tons only. When cubes requiring a greater pressure to crush them were being tested this second gauge was shut off by a valve.

On account of the high values which were obtained at the beginning of the work, suspicion was directed towards the accuracy of the machine, but comparisons of the cubes by testing on an accurately gauged machine at the testing laboratory of Columbia University showed that the small press used on the work was correct within reasonable limits.

For each test two cubes of 1:2 cement and sand mortar were made. The sand was taken from that used on the work and was washed clean. To insure uniformity a sufficient quantity for all the tests was taken at one time and stored in a bin until required. For each test a little in excess of 128 cubic inches of sand and half as much by volume of cement were used. The sand and cement were mixed dry, then sufficient

water added to make a fairly wet mixture; that is, one that was readily muddled, but would not pour. The whole was then well mixed and placed in the molds and puddled with a small trowel. All the operations were done by hand. As soon as the mortar was sufficiently set to hold the markings the date and hour were marked on both cubes and the mold placed in the damp closet. At the end of twenty-four hours the mold was taken from the damp closet, the forms removed and one cube crushed. The other cube was submerged in a pan of water, where it remained for six days, and was then crushed. All specimens were tested to failure.

To prevent little inequalities of the surfaces of the cubes from seriously affecting the results, three thicknesses of blotting paper were used on top and bottom of each cube in the press. After some time it was discovered that the long sides of the gang molds were more nearly parallel than the others, and thereafter care was taken to use the sides of the cubes formed by them as the crushing faces. By this means better and more nearly uniform results were obtained.

Every scow load of sand was tested for percentage of loam. If the sand in different parts of the scow appeared to be of different quality, more than one test was made. This test consisted in taking a quantity of sand and drying it thoroughly on a stove. A thousand grams of it was then taken in a 12-quart pail and washed by turning on a hose, giving the water as it flowed from the hose sufficient velocity to keep the mass stirred up and moving, the loam being carried off in the overflow. When the water ran clear the sand was again dried and weighed, the difference in weight giving the percentage of loam. Sand containing more than 2 per cent was rejected. Tests were also made to determine the comparative fineness of the sand. These were only made when there appeared to the eye to be a difference in the grade. The test consisted in taking a measured quantity of sand (by weight) and screening it by hand through 20-mesh and 30-mesh sieves. These tests showed on an average about 21 per cent retained on the 20-mesh sieve, 27 per cent on the 30-mesh sieve, and the remainder passing through the 30.

Occasional tests for percentage of voids in the sand were made as follows: A comparatively large amount of sand was measured and weighed to show the average weight per c.c. Then a quantity by weight corresponding to 50 c.c. was put into a glass graduate and the volume of water displaced measured. The average volume of voids was thus found to be about 40 per cent.

As the grade of the crushed stone varied but slightly, only occasional tests were made to determine the percentage of voids in the stone. To do this a quantity of stone was submerged in water for two hours to permit it to become thoroughly saturated. The water was then poured off and the stone exposed to the air half an hour to permit the surface moisture to evaporate. A vessel of known cubic capacity (nearly 10,000 c.c.) was then filled with the stone and weighed. Sufficient water was added to fill all the voids and weight taken again. The difference in weight showed the percentage of voids. As there was excess of voids around the sides of the vessel, this test is only comparative and is not considered particularly important, as the inspector can best judge by the appearance of the batch when the voids are properly filled. For the stone used on this work the voids measured by the above method averaged nearly 50 per cent. Measurements of concrete in place and stone on the scows indicated that the volume of stone used was about 97½ per cent that of the concrete produced.

What seems to us the most important test and the test of most practical value was that of the crushing strength of concrete itself as it was placed in the forms for the building. For these tests the same apparatus was used as for the mortar tests. The preparation of the test specimens was simpler. The gang mold for four 4-inch cubes was taken into the work where concrete was being poured. The concrete was taken from the buggies as it was being poured into the forms and was immediately placed in the cube mold and puddled with a small trowel. There was no excessive puddling as it was intended to approximate working conditions as nearly as practicable. One and sometimes two tests were made every day concrete was poured. From this time on the operation was similar to that for testing mortar. After 24 hours in the damp closet the forms were removed, one cube crushed and the three others submerged in a pan of water. Of these three, one was crushed at the end of seven days, one day in the damp closet and six in water; one at the end of 8 days and the other was removed from the water at the end of 8 days and laid aside to be tested later. As has already been said, no attempt was made to preserve an even temperature in the laboratory, the object being to maintain as nearly as practicable the condition of the concrete in the work, so that it sometimes happened during the winter that ice formed on the water in the pans where the test cubes were submerged. The effect of this is clearly shown in the results of the tests. A practical use of the tests of concrete was to indicate to the inspector as well as to the contractor the safe time for wrecking his forms. This time was fixed at first at seven days, but was afterwards shortened to four days during the summer and well into the fall, when the decreasing strength of the cubes tested caused the time to be again extended to seven days.

The results of these tests on the whole were so satisfactory and the information obtained was deemed of such importance that they were continued for another piece of work which was done during the summer and fall of 1911. This latter work consisted of the reconstruction of a block of six warehouses. The whole block is 210x374 feet in plan and four stories high. The buildings were of the old type, brick walls with wood interior. All the wood was removed and replaced by reinforced concrete, making the building fireproof throughout. As this work was done with greater dispatch than the first job, it was thought best to have more inspectors. Consequently a chief inspector was put in charge of the whole work, assisted by one inspector over the proportioning and mixing, one on placing concrete and one solely for making tests. This arrangement worked very satisfactorily and allowed the engineer to devote more of his time to other work.

There is nothing notable in the results of the tests for fineness, constancy of volume and specific gravity, except that they show what may be expected from the ordinary inspector who is not specifically trained in making such tests, and where the tests are made under the conditions prevailing on the ordinary job. The results of the tests for initial and final set were so varied, due, no doubt to the changing temperature, that they lack value as determining the quality of the cement.

Tests of the cubes of 1:2 cement and sand mortar were intended to show a definite relation of strength of the cement being tested to what could be expected from the concrete made from the cement. Comparisons of the results of these tests with the results of the tests of concrete were so simple and proved so satisfactory that it is believed they show with sufficient accuracy the practical rate of setting of the cement and

that the tests for initial and final set could be discontinued for field laboratories.

The average strength of the 173 tests of 1:2 cement and sand mortar on the first job was 448 pounds per square inch in 24 hours and 2,075 pounds per square inch in 7 days. On the second job, where a different brand of cement was used, 198 tests were made and the average strength was 570 pounds per square inch in 24 hours and 2,025 pounds per. square inch in 7 days.

CAUSE AND PREVENTION OF CONCRETE FAILURES.

It is a peculiarity of the failure of every concrete structure, where the primary fault is in the design or construction of the concrete or of its reinforcement, that a very apparent cause can soon be found, and that that cause is one which should have been apparent to anyone claiming more than an elemental knowledge of the science of building in concrete.

With a regularity almost monotonous we read of insufficient reinforcing connections, of improperly mixed concrete, of frozen material, of thin supporting struts and of premature removal of forms, until we wonder what is the nature of men who will not learn the fundamentals of a business at which they hope to earn their living.

There does not seem to be any good reason why the concrete building business should not be conducted in the same manner as the building of steel structures. Why should not every architect be competent himself or have associated with him an engineer competent to design the concrete structure? Why should not this expert prepare the general structural drawings for the building upon which competent contractors may bid? Once the bid is awarded, taking into account both the competency of the bidder and the prices bid, the successful contractor could himself prepare the detail plans showing method of erection, minor steel details, etc., exactly as the steel companies now prepare shop drawings showing erection methods and connection details for the approval of the designing and supervising engineer of a structural steel building. This would remove the commercial element from design and would surely tend toward safer buildings. Such methods are very generally in use, and the buildings so erected are of the class which make the reputation of reinforced concrete as a building material.—From Engineering News.

CONCRETE LIGHTING STANDARDS.

We have just received an order for 300 reinforced concrete lighting standards similar to those which were recently described in a write-up in your publication, writes the Pettyjohn Co., Terre Haute, Ind. Of this number 220 of the standards are to be used in Washington and Lincoln Parks of Springfield, Ill., while the remainder are to be used in the boulevard system.

Springfield has unusually large and handsome parks, which are the pride of the city, but previously they have been inadequately lighted by lights on iron poles. This order is especially gratifying to us and should be also of interest to all cement users in view of the fact that Springfield has previously used standards made of a combination of cast iron base and sheet metal shaft, while the neighboring cities have been using concrete. The present specifications were definitely for concrete, and that in itself speaks volumes.

We have also received orders for an installation as far west as Dubuque, Iowa, and numerous orders from cities on the Atlantic coast.

LUBRICATING EXPERIENCES.

Grease Versus Oil.

By F. M. N.

In the cotton seed oil industry steady running is of prime importance towards good manufacturing. I early discovered that clean machinery plays no mean part in keeping the mill up to the scratch, and making the seasons crush without loss of time, due to breakdowns. Working in line with the above, I have dispensed with oil as a lubricant wherever possible or where it would collect dust and lint on the bearings. After trying out different greases in spring and hand compression cups on various machines, the best results were obtained from a soft grease that would not flow or change its density under any heat that the bearings would stand, by fitting the cups so that the grease could be forced to the spot needed and not depending on the bearings warming up to supply lubricant.

In one machine we force grease through about 4 ft. of ⅜-in. pipe with a plain steel hand compression cup. To facilitate this a piece of ⅛ by 1-in. iron was riveted to top of cup so as to give a better grip on it. This suggests the idea of dropping a pipe with cup attached from shaft bearings or bearings of any kind that are just out of reach from floor or platform.

Change from oil to grease was very satisfactory on this mill engine, a 16 by 42-in. Atlas Corliss, 100 r. p. m. Due to lint and dust, this engine would look like a woolly sheep at the end of a week's run, 24 hours a day. The flying dust would collect wherever there was oil on exposed surfaces, forming dirt that could not be blown off, but must be wiped off. I fitted this engine with one 3-oz. spring cup on the wrist pin, one 4½-oz. spring cup on crank brass, hand compression cups on bearings, eccentrics and top and bottom guides, also on rocker shaft, wrist plate, and governor bearings.

We ran this engine last season equipped as above for 6 consecutive months, 24 hr. a day, 137 hr. a week, with a loss in the mill of less than 2 hr. working time for the season; and this shut-down was not due to engine failure.

The 3-oz. and 4½-oz. cups on wrist pin and crank were filled once a week; the other cups could be filled while running and were not fed as steadily as the spring cups would feed, but were usually filled every fourth day. I had some trouble at first with spring cups failing to feed when half empty the latter part of a week's run, and could not overcome this trouble with the ordinary spring compression cups.

I ordered 2 cups that did away with the trouble from the France Packing Co., Philadelphia, made with the cup body leather threaded to screw into body by hand as the cups were emptied of grease, thereby keeping a uniform tension on the spring.

We would screw these sleeves in about 1 or 2 turns every morning, as we made it a practice to stop the engine for a short period while the night and day shifts were changing. The engine ran through the season without bearing trouble, was kept very clean and the grease was not wasted as the oil had been; also in line of economy 1 lb. of grease at 15c would do the work of 2 to 3 or even 4 gal. of oil at 20c a gallon, and on some bearings in the mill that were attended to by negroes the change to grease stopped considerable waste.

This season the mill is being driven by a bituminous gas plant, a 3-cylinder vertical gas engine installed by the side of the old Corliss, and this new comer is just as steadily on the job as the other.

The Construction of Concrete Pavements

By A. M. Compton*

The use of Portland cement concrete pavements for public streets and roadways in the city of Davenport and its enviornments has been almost developed during the last three years.

The first street so paved was completed in the fall of 1909 and comprised only a little over 3,000 sq. yds. In 1910 about 16,000 sq. yds. were laid. This was widely distributed and consisted of small jobs, and the type was considered as a more or less dubious experiment. By the spring of 1911, some of the paving laid to date withstood two winters and two seasons of traffic. Its condition at that time seemed to warrant the continued use of concrete. During 1911 there were laid over 18,000 sq. yds. of concrete paving in the city, and the adjoining town of Bettendorf, with a population of about 900, laid in the summer of 1911 a little over a mile of concrete paving in its main street, consisting of nearly 29,000 sq. yds. in one job.

Up to the present date, Davenport has either contracted or advertised for bids for nearly 40,000 sq. yds. of concrete street pavement to be constructed during 1912.

With one exception all the concrete paving laid in the city has so far been on residence streets, where there is no continuous heavy traffic, and has stood up under both weather and traffic conditions in a satisfactory manner.

Early Experience.

The city, a number of years ago, paved several rather steep hills with beveled vitrified brick with a tellford macadam strip 10 feet wide in the center. These macadam strips washed badly and were in an impassable condition within a few years. We have recently replaced these center strips with a one-course concrete pavement from 4 to 6 inches thick and corrugated with a "hit or miss" tamper. The grade of these hills varies from 9½ to 12 per cent, and in one instance the paving receives very heavy traffic. It has been noticed that teamsters generally prefer to drive on the concrete center strip rather than on the brick sides. The only signs of failure so far have developed at the transverse expansion joints which were left unprotected save for a sand filler. In fact none of our concrete pavements so far have shown any failure under traffic save at the expansion joints.

In 1909-10 the concrete pavement was laid under specifications briefly as follows: A 5-inch base of 1:3:5 concrete with a wearing surface of 1:1 sand mortar was corrugated transversely with tooled grooves about 8 inches apart. The mineral aggregate was river sand and 1½ inches crushed limestone. A transverse expansion joint filled with pitch was required every 50 feet. In 1909 the price on the only piece laid was $1.25 per square yard; in 1910 the price varied from $1.27 to $1.37 per square yard. The same year a number of residence alleys were paved with one course of 1:3:5 concrete 6 inches thick and rough finished, at an average price of $1.11 per square yard. During the fall and winter of 1910-11 the writer noticed that almost without exception these blocks of paving, 50 feet long and 30 feet wide, had developed irregular contraction cracks. While these cracks were negligible as to size they were without question a failure and detrimental to the life of the pavement.

With the idea of a general bettering of the work and in an endeavor to do so without materially increasing the cost, our specifications were changed before the season of 1911 to call for a 5-inch base of 1:3:5 concrete with a 2-inch wearing surface of 1 part cement to 2 parts sand, a 2-inch transverse expansion joint every 25 feet, and a 1-inch longitudinal expansion joint along either curb and a 1⅛-inch contraction joint midway between the transverse expansion joints. All joints have tool rounded edges and are filled flush with asphalt. This divided the work into blocks of 12½ by 30 feet and so far has practically eliminated all contraction cracks. The concrete pavement under this specification was laid in 1911 for $1.25 to $1.30 per square yard.

During the season the city also laid several thousand yards of concrete pavement consisting of a single course 6 inches thick of 1:2½:4 concrete with the mortar flushed to the surface, floated, and either broom-finished or corrugated, as the grade of the street required. This was laid under contract at a cost of 93 cents to $1.10 per square yard.

Reinforced Concrete Pavement.

During this same season our department was required to pave a street the sub-soil of which was decidedly treacherous, consisting largely of sawmill refuse, such as sawdust, chips, bark, etc., filled above the nautral surface of the ground to a depth of from 6 to 12 feet and saturated with river water. Both railroad and street railway tracks which parallel and adjoin this street settle from 18 to 24 inches annually where they cross this fill. As this street would be subject to heavy and high speed traffic, in the writer's opinion, a flexible type of pavement, such as the various forms of macadam, would neither withstand the traffic without constant repair nor be in the least self-supporting over what seemed almost certain excessive and unequal settlement.

A good brick or asphalt pavement with concrete base was discussed, but owing to the writer's experience with concrete base failures, due to trench settlement, and owing to the excessive cost to the city for this type of pavement, because of adjoining park property, these types were abandoned. It was finally decided to use reinforced concrete pavement, to consist of 7 inches of 1:3:5 concrete with ½ per cent steel mesh reinforcement placed near the lower surface of the concrete. It was thought that this type would more successfully withstand the settlement and still come within the requirements of a very moderate first cost. It was planned with the idea of placing either a brick or an asphalt wearing surface upon it if, in the future, the surface should disintegrate or ravel badly under traffic.

The successful contractor laid this pavement in the summer of 1911, using a sufficient amount of American Steel & Wire Company's wire fencing as reinforcement, for 93 cents per square yard. During and immediately after its construction we experienced several weeks of excessive and continual rainfall, leaving the sub-grade in a jelly-like condition. The curbing settled badly but so far no signs of failure in the pavement have developed, not even contraction cracks, though during its life so far it has experienced a range of temperature of 113 degrees. As to the surface wearing qualities of 1:3:5 concrete, another year of the heavy traffic that this street receives should tell the tale.

*Commissioner of Public Works, Davenport, Iowa.

Present Practice.

Owing to the very general demand of property owners this season by petition, and otherwise, for concrete paving, the writer has again changed his specifications in the effort to obtain, if possible, the best and most substantial concrete pavement compatible with a moderate first cost. The present specifications call for a five-inch base of 1:3:5 concrete upon which is laid a wearing surface, not less than 1½ inches in thickness at any point, consisting of 1 part cement, 1 part of sand, and 1 part ¼ to ½-inch granite chips; transverse expansion joints consisting of creosoted long leaf yellow pine blocks 1 inch in thickness, placed with the grain vertical 20 feet apart, and the same longitudinal joints along the curbs as before specified. The prices received so far this season upon the pavement to be built under this specification have varied from $1.00 to $1.17 per square yard.

In Davenport we have approximately 1,500,000 square yards of pavements. of which only 38,000 yards are concrete, so that it will be seen that this type of paving is in its infancy. It has demonstrated its advantages particularly in certain localities desiring or requiring street improvements in order to develop, and where abutting property is of such a type and character that to lay either brick or asphalt would not only be a hardship to the property owner but also would burden the city with a large excess of cost.

Based on our experience so far the first cost of our concrete paving is only about 65 per cent of the cost of brick paving and about 59 per cent of the cost of asphalt paving. It is the writer's opinion that this type of paving will give satisfactory service in such localities for at least ten years, and at the end of that time be in such shape that either an asphalt or brick wearing surface may be laid directly upon the concrete paving as a base. We are designing our curb height and crown of street so as to permit so doing in the future. In ten years the difference in first cost plus accrued interest will much more than pay for a first-class asphalt wearing surface.

One of the main objections to this type of pavement in the past has been the fact that it was a slow type during construction, but the Bettendorf paving work laid last fall demonstrated that that type of concrete paving consisting of a single course of 1:2⅜:4 concrete, 6 inches thick, could be satisfactorily laid at the rate of from 1,200 to 1,800 square yards per day. This work in Bettendorf furnishes one of the best examples of the availability of concrete pavement where no other permanent type is possible. The City Council of Bettendorf required a paved street not less than 40 feet between curbs, while nearly all the adjoining property would show a valuation of not over $12.00 per front foot. Under the Iowa State law this valuation would limit assessment to a little under $3.00 per foot, which rendered absolutely impossible the use of either brick or asphalt.

The writer prepared plans and specifications calling for bids on 29,000 square yards of concrete paving to be mixed 1:2½:4 , with mortar flushed to the surface with a bar temper, floated and broomed; expansion and contraction joints to be placed dividing the work into blocks 12½x20 feet, and all to be filled with an asphalt filler. There were also 18,000 cubic yards of excavating, 11,000 lineal feet of 18-inch concrete curb, 12,000 lineal feet of 12-inch concrete curb. This latter was placed around a 10-foot center boulevard strip which was left for the purpose of receiving a probable street railway line. The successful bidder on this work took the contract at 85 cents per square yard, 30 cents per cubic yard for excavation, 18 and 20 cents per foot respectively for the curbing. The ground for this work was first broken in the middle of September and the pavement was completed and open to traffic in the middle of December.

During the past season several thousand square yards of concrete roadways and drives in private grounds have been constructed under the supervision of local engineers. Both the single course type and the two course type have been used with equally satisfactory results.

Objections to Pavement.

One feature of this work has been the coloring of the concrete to prevent the objectionable sun glare from the dead white surface; this feature is particularly noticeable when the roadway is directly edged with grass and trees. From ½ to 1 pound of lampblack per barrel of cement was used, and the resulting slate-colored or light gray effect is most pleasing to the eye.

One of the most objectionable features in the use of concrete street paving is the length of time that must elapse after completion before traffic may be permitted thereon. We never open a new concrete street until at least ten days have passed after the time of placing the last concrete, and in some instances of unfavorable weather conditions, we have required thirty days.

In the writer's opinion, the expansion joint is the weak point of this type; as soon as actual test has proven some scheme for protecting expansion joints successfully, then is concrete paving a success.

The writer particularly desires to emphasize the fact that proper inspection is essential and that all cement used in the construction of concrete paving should be properly tested by the city before its use in the street. Since there is being laid more and more of this type the city owes to its taxpayers the protection given by at least a complete 24-hour test on all cement used. We all appreciate what would be the result of the use of only one carload of defective cement in a concrete pavement and it is the duty of all engineers in charge of such work to obtain such tests if they are at all possible.

REINFORCED CONCRETE BOAT.

A very large reinforced concrete boat has recently been built for the use of the Manchester Ship Canal Co. in England. This boat is described in the June 4, 1912, issue of London "Engineering." From that account we have made the following abstract:

The boat in question is known as a sludge pumping pontoon. It has been built for the purpose of enabling dredged material to be deposited on low-lying land anywhere along either bank of the ship canal. The pontoon will be towed by steam tugs to selected points and there moored. The hopper barges will then be towed from the dredges as they are filled and moored alongside the pontoon. The suction pipe of the pontoon will be lowered into the barge to be discharged and the delivery pipe will deliver material upon the area selected for its reception. The pontoon is equipped with its own boilers and engine for the pumping operation described. It is 100 ft. long by 28 ft. wide, and 8 ft. 6 in. deep from the keels to the main deck, drawing about 6 ft. 6 in. of water when fully loaded. Its entire construction, including four watertight bulkheads and settings for the boilers and engine, is of reinforced concrete. The pontoon was built according to the Hennibique system by the English agents of that system, Messrs. L. G. Mouchel & Partners.

The Design and Construction of a Seven-story Reinforced Concrete Mercantile Building

By E. I. Silver, C. E.

The design of a mercantile building demands necessarily the three following features: First, general arrangement of the floors; second, architectural treatment; and third, structural design.

The first is governed by the nature of the industries for whom the building is intended, the amount of shipping provisions necessary, the divisions of the floors

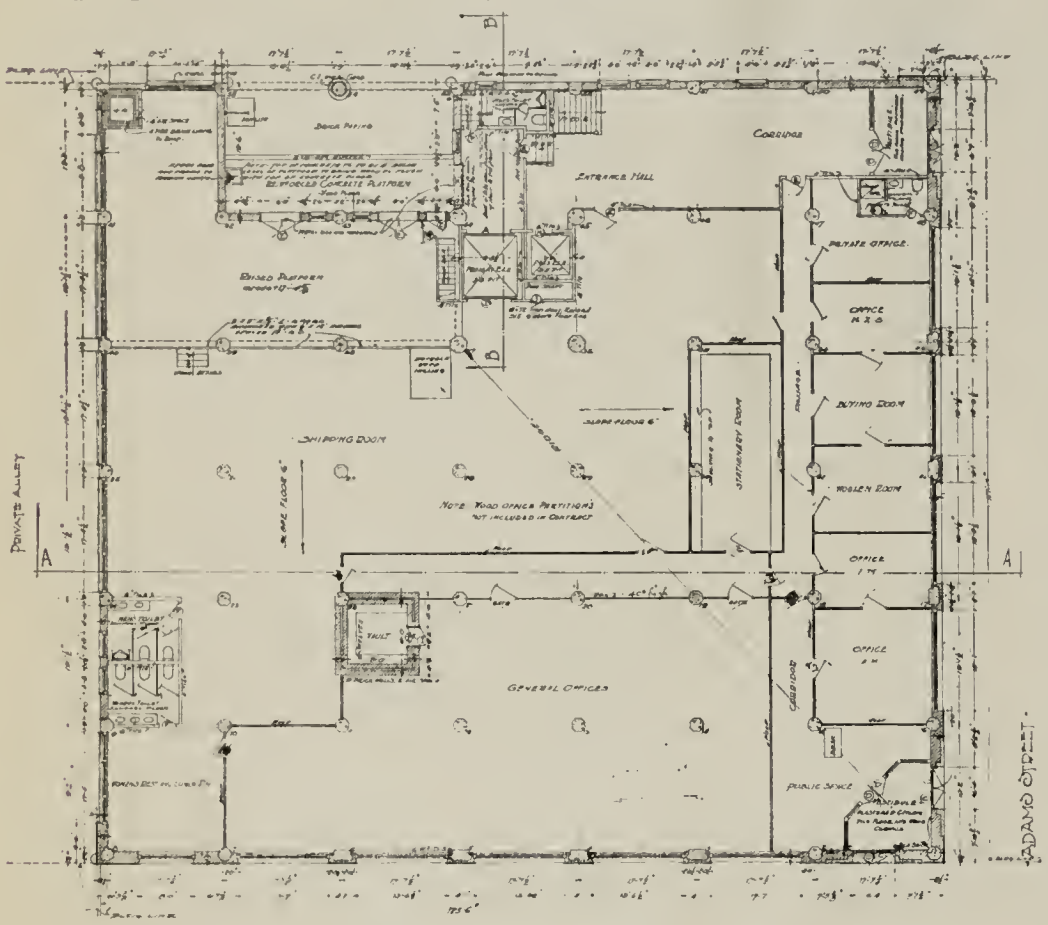


Fig. 1. Floor Plan.

into special rooms as are required, the division of space for private and general offices, the amount of toilet room space, etc. The lay-out of the stairways will be governed both by the occupant and the city building law requirements. The city building laws will determine the width of stairways, which is dependent on the square foot of floor space on the various floors.

The architectural features are necessarily governed by the locality in which the building is to be constructed, the area and height of the building, the class of industries which are to occupy the building, and the appropriation of money that can be used to the best advantage.

The structural design depends upon the floor loading requirements of the various industries which will occupy the floors, the arrangement of columns in order to allow the occupants a maximum sufficiency in connection with this floor space, and the requirements of the city building laws.

The building which will now be described, both in design and construction, has just been completed, and is located at the southwest corner of Adams and Green streets, Chicago, Illinois.

The dimensions of the building are 125 feet 6 inches facing on Adams street and 117 feet facing on Green street, as shown in the first floor plan of Fig 1. The building is of reinforced concrete construction and is of skeleton design so that the brick work need not progress until the entire concrete work is finished. It is seven stories in height, making the top of the front coping about 96 feet above the sidewalk line. There is no basement, excepting the boiler room portion, which is shown in the rear and is located below the raised shipping platform. The height of the first floor is at the street level.

In discussing the design of this building we will divide the discussion according to the three features as mentioned above.

General Arrangement.

First, as to the general plan. The building is to be occupied chiefly by wholesale tailoring concerns and the columns have been arranged to suit their requirements as is necessary for the lay-out of cutting tables, sewing machines, sponging equipment, etc.

The columns as well have been laid out for the most economical structural design. The typical panels are 17 feet 7½ inches center to center columns east and west, and 19 feet 1½ inches center to center columns north and south, and under this lay-out the two-way system of reinforcing can be very economically used.

The first floor, as shown on the accompanying drawing (Fig. 1) is laid out for offices, and shipping and receiving rooms; the entrance at the corner is used solely for access to the office department, while the entrance, shown on the west, is for the various floors above.

It is well to note that the various floors above can be subdivided into two separate parts, and by installing a partition from the east line of stairway shaft across the center of the floor to the east wall of the building, the separate parts can be made exclusive and still have all facilities necessary, such as elevator, stairways, etc. In so doing, however, it will be necessary to enclose a small space in front of the freight elevator,

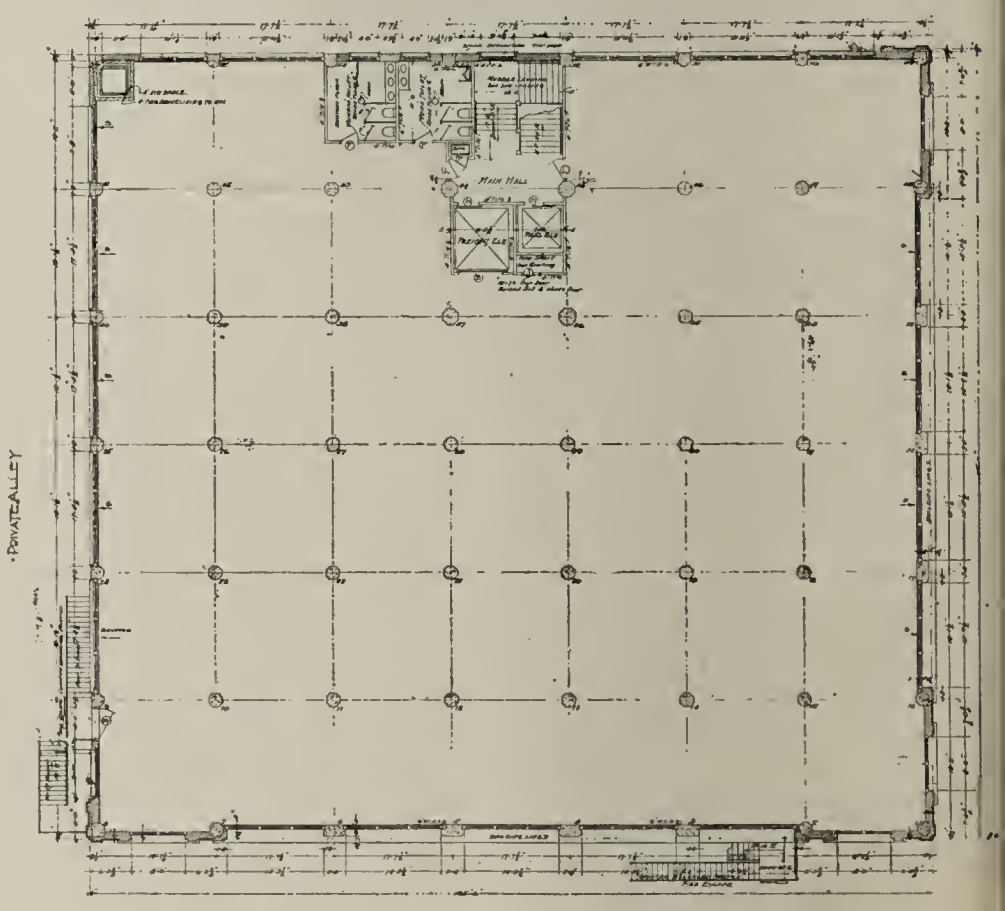


Fig. 2. Typical Floor Plan.

which is to be made common to both occupants of the floor, with one door leading to each part of the floor from this common space.

Another important feature is that the freight elevator can be used as passenger elevator in the rush hours, if necessary. The shipping space in the rear of the building is arranged so that the first floor can ship

directly through the two doors as shown and the various other tenants on the upper floors through the elevator and shipping floor, shown on the north side, making the loading platform arrangement independently suitable for all floors.

The typical floor, as shown in Fig. 2, applies to the second, third, fourth, fifth and sixth floors.

Installing the stairways, elevators and toilet-rooms

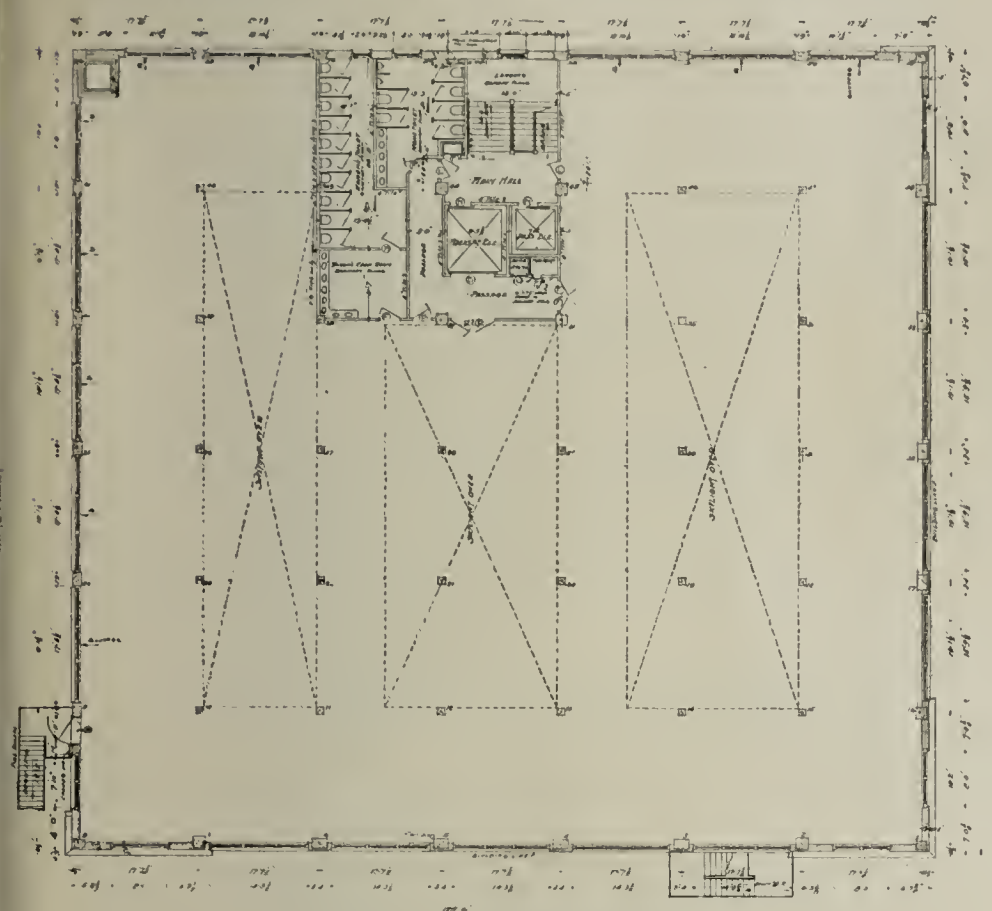


Fig. 3. Top Floor Plan.

in one location, as shown, allows the occupant to have his general floor space entirely together. General toilet provisions have been provided and are governed by the city and state regulations.

Access to the various floors is provided only through the doors marked L, which are arranged to be locked, and accordingly each floor can be cut off entirely from the other floors.

The building has been designed for the maximum amount of light by allowing the windows to take up the entire space between the columns and extend from the top of the small spandral wall clear to the ceiling of the floor. Concrete lintels over the window heads have been turned up, which allows the windows to extend entirely to the ceiling. The building is accordingly well adapted for manufacturing purposes on account of this maximum amount of light that can be obtained.

The fire-escapes are conveniently arranged for rapid exit, complying fully with the building laws.

The seventh floor, as shown in Fig. 3, has been laid out for a manufacturing floor, and accordingly every foot space must be well lighted. There are three large skylights in the ceiling, as shown, which introduce the north light only. By using the saw-tooth sky light, the intense heat of the sun is kept out, and this north light, which is most desirable of all, is admitted.

The floors are well ventilated by means of large ventilators located in the sky lights.

Architectural Features.

The architectural design is that of the modern mercantile building. The two street fronts are a combination of terra-cotta, brick and concrete, in conjunction with the special design of window frames and sash.

Up to the second floor the piers are entirely of brick with a small amount of terra-cotta trimming, and are tied together by the heavy band at the second floor, which is topped off with a continuous terra-cotta sill course.

The entrances, however, are of special design, as shown in Fig. 4, the entrance openings being entirely surrounded with terra-cotta containing the brick ornaments, as shown, and each entrance is also equipped with two ornamental electroliers at the transom line.

Above the second story terra-cotta sill, the outside end piers, on each street front are entirely of brick with a small amount of terra-cotta trimming and are tied together with a heavy brick band at the seventh floor and roof lines, as shown.

The intermediate exterior columns from the second floor line and base, as shown, are entirely of concrete exposed to the seventh floor line where they terminate with a concrete ornamental cap. These concrete columns were cleaned down and painted with two coats of cement paint.

The two street fronts are the only exterior parts of the building which are ornamented, excepting the small pressed-brick bands around the gravity tank structure.

The remaining two elevations have only common brick with the concrete skeleton exposed, as shown in Fig. 5.

The first floor windows on the two street fronts are a combination of store-front and double-hung window design and accordingly afford a window display in the store front portion if wanted.

Structural Features.

The structural details of the building are shown in Figs. 6, 7, 8, and 9. The assumptions, formulæ, etc., upon which their design is based, will now be taken up.

The floor panels, Fig. 6, are designed on a live load basis of 100 pounds per square foot, and the roof slabs on a live load basis of 25 pounds per square foot. Taking a dead load of 75 pounds per square foot for a six-inch floor panel, and assuming that the bottom rods on short span take 55% of total load and the top rods, 45%

Fig. 4. Front Elevation, Green and Adams Streets.

of total load, we continue to design the panel on assumptions of formula $M=Rbd^2$. A live load of 100 pounds per square foot plus a dead load of 75 pounds per square foot gives a total load of 175 pounds per square foot, which multiplied by 55% gives 97 pounds per square foot taken care of by the bottom rods, leaving 78 pounds per square foot for the top rods.

Fig. 5. Rear View, Showing Concrete Skeleton Construction.

Having found the percentage of load in pounds per square foot taken by the top and bottom layers of rods, we proceed to find the area of steel necessary to balance the load by first finding the depth of slab. By using a value of 700 pounds per square inch for compression in the extreme fibre of the concrete, and 16,000 pounds per square inch for tension in the extreme fibre of the steel, and with a ratio of steel to concrete of $n=15$, and a percentage of steel of .0073, we derive, by standard formula, a constant $R=113$.

By using the formula

$$M=Rbd^2$$

where M is the bending moment in inch-pounds,
R is a constant, in this case 113,
b is the breadth of beam, 12″,
d is the depth of steel in inches,
and solving for d, we get

$$d=\frac{Rb}{M}$$

Substituting values, we have

$$d=\frac{97\times17.5\times17.5\times12}{113\times12\times12}$$

$=4.7$ inches to center line of steel.

For total number of bars in span,

$$N=\frac{d\times b\times p\times\text{span}}{\text{area of bar}}\times7/9$$

Substituting the value of $p=.0073$, percentage of steel, and using ½″ square bars, we get for a span of 17′7½″ (practically 18′)

$$N=\frac{4.7\times12\times.0073\times18\times7}{.25\times9}=22 \text{ bars.}$$

The constant, 7/9, is taken from Turneaure & Maurer, and explanation can be found in that text-book, as the discussion is too long for this article.

For top layer of rode $d=4.6$″ and $N=22$-½″ rods, calculation being similar to that above.

In determining the total thickness of panel we add 4.6″, which is distance from top of slab to center line of top layer of rods, .7″ between centers of bars, .35″ from center of lower bar to edge, and .5″ from lower edge of bar, to under side of slab, which gives us, for practical purposes, a 6½″ panel.

One-half of the rods are placed in the center third of the panel and one-quarter of rods in each remaining third, spacing the center third 6″ on centers and remaining rods equidistant to beams. Since the panel has been figured as continuous over two supports, using a bending moment of $WL/12$, the same number of top rods is put over the support a distance of two-fifths of the span to develop the full strength of steel at this point, as the bending moment at support is the same as at the center line of panel.

For end panels proceed as above outlined except in place of bending moment $WL/12$ use $WL/10$.

The beams or girders, Fig. 7, were figured as T-beams, using a value of 700 pounds per square inch in compression for the concrete and a value of 16,000 pounds per square inch in tension for the steel. Using the formula $M=WL/12$ for the bending moment at center line of beam, or $M=WL/6$ for the total moment at the center line of beam and support, the bending moment M is found for use in the formula for T-beams.

$$A_s=\frac{M}{f_s\times d\times.86}$$

where A_s is the area of the steel in square inches,
f_s is the fibre stress in steel,
d is the depth of steel,
.86 is the ratio of arm of resisting couple to d.

Assuming the beams 10″ by 20″ we find the loading, which for a 19′1½″ span is, under a load of 97 pounds per square foot.

$$19'1\tfrac{1}{2}''\times17'7\tfrac{1}{2}''\times97=34{,}000 \text{ pounds,}$$

to which add 4,000 pounds for the weight of the beam, which gives a total load of $W=38{,}000$ pounds. Therefore

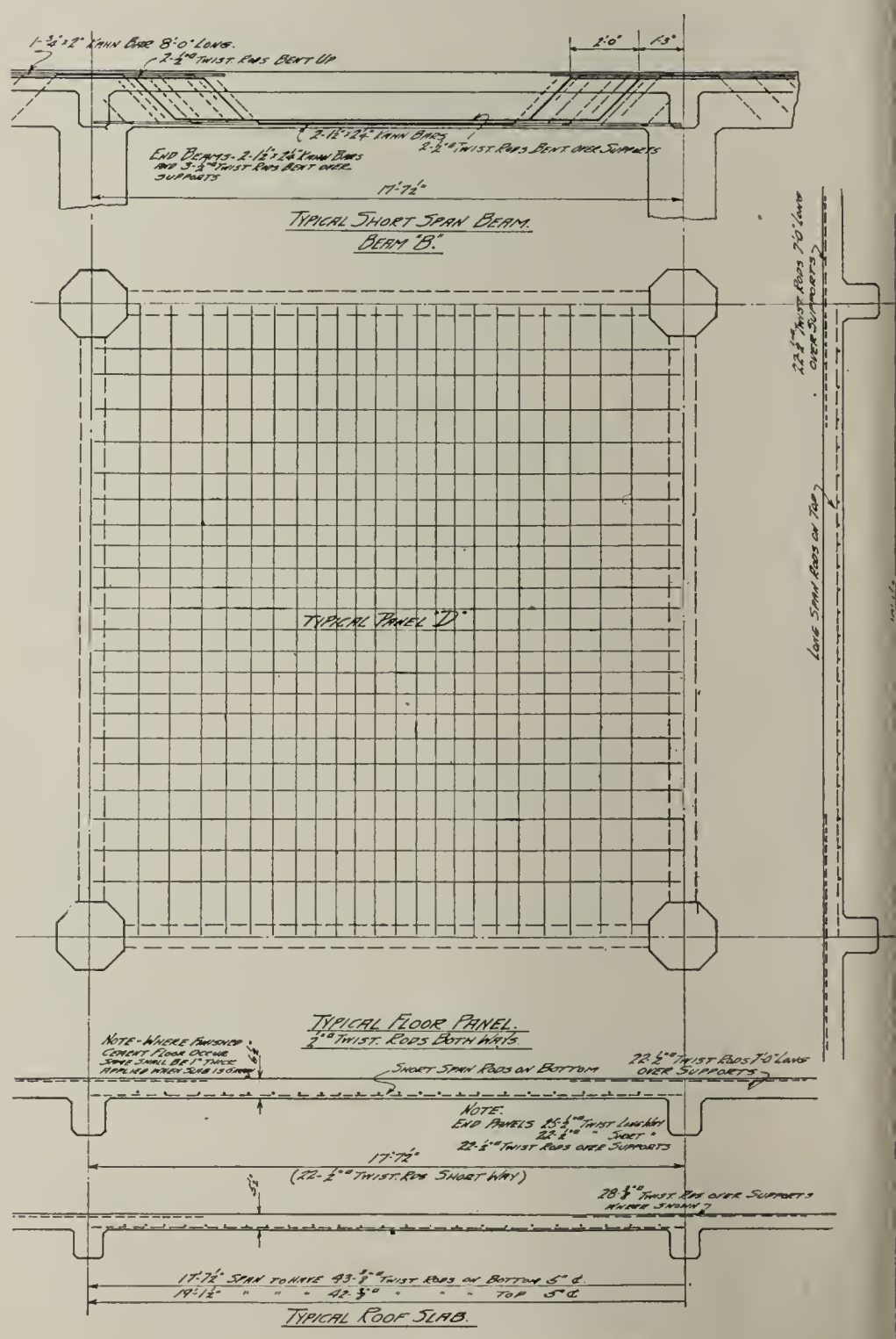


Fig. 6. Typical Reinforced Concrete Floor Panel.

$$M = \frac{38{,}000 \times 19 \times 12}{12} = 725{,}000 \text{ inch-pounds.}$$

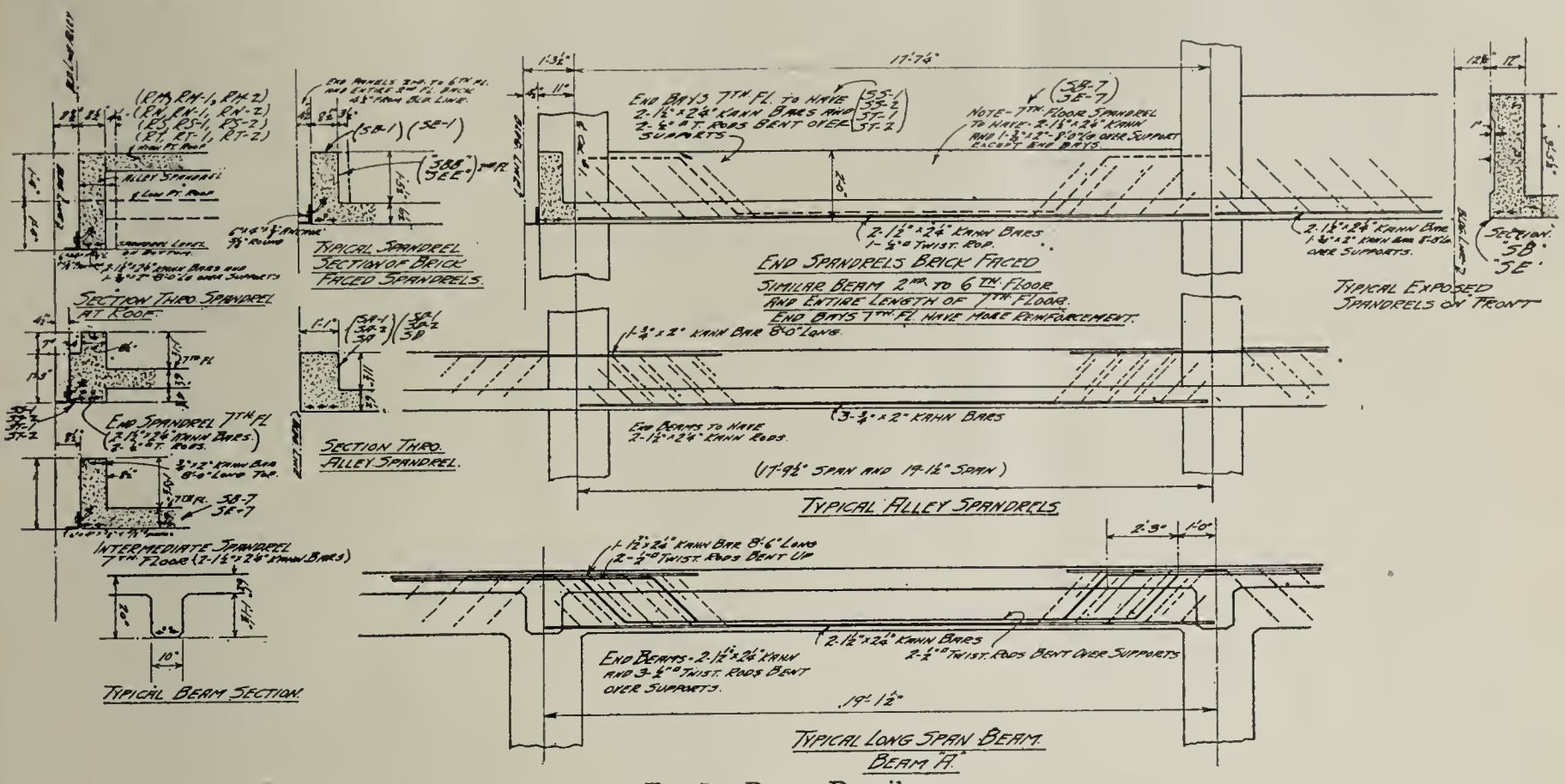
and

$$A_s = \frac{725{,}000}{16{,}000 \times 18 \times .86} = 3.1 \text{ square inches.}$$

Use two 1½″ by 2¼″ Kahn bars, and two ½″ bars, these giving a total area of steel of 3.3 square inches.

hooped columns, in order to keep them as small as possible, and 1-1½-3 concrete mixture was specified for first, second, and third floors, while for the remaining floors a 1-2-4 mixture was specified.

The footings, Fig. 9, were figured in accordance with standard methods, using a high elastic-limit steel, 1-3-5 concrete mixture, and a soil bearing pressure of 3,500 pounds per square foot. The allowable bearing pressure



Fg. 7. **Beam Details.**

Since the beams are figured as continuous, put the same amount of steel over support, using two 1½″ by 2¼″ Kahn bars 7′9″ long, and bending two ½″ square twisted bars over supports for the same distance. For short span beam proceed in the same manner, figuring load as

$$19'1\tfrac{1}{2}'' \times 17'7\tfrac{1}{2}'' \times 78 = 26{,}000 \text{ pounds,}$$

to which the weight of beam (4,000 pounds) is added, giving a total load of 30,000 pounds. End beams are to

of top plate under column was figured at 350 pounds per square inch, and a shear value on a diagonal plane of 40 pounds per square inch was used.

Construction.

The amount of excavation was not very great for the reason that there was no basement to the building. The only excavation required was for the boiler footings, the boiler room space and the pier and wall footings, which went down to hard blue clay at a depth of 7′6″.

		13'-10" Basement 7'-0" Bottom of Footing Unless Noted	12'-6" 1st Fl.	12'-6" 2nd Fl.	12'-6" 3rd Fl.	12'-6" 4th Fl.	12'-6" 5th Fl.	12'-6" 6th Fl.	12'-4" 7th Fl.	2'-0" Low Pt. Roof	32'-6" High Pt. Roof	Bent Hse.
Interior Cols.	Cols. 10 to 15, 18 to 23, 26 to 31, 34, 35, 38, 39, 42, 43, 46, 47	25" Oct. Cols. 8-1¼"ø Rods ½"x4" Hoop-1½" Pitch Conc. 1-1½-3.	25" Oct. Cols. 9-⅞"ø Rods ½"x4" Hoop 1½" P. Conc. 1-1½-3.	25" Oct. Cols. 8-1"ø Rods ½"x4" Hoop 2" P. Conc. 1-1½-3.	23" Oct. Cols. 8-1"ø Rods, ½"x4" Hoop-2½" P. Conc. 1-2-4.	23" Oct. Cols. 6-1"ø Rods ½"x4" Hoop-3" P. Conc. 1-2-4.	23" Oct. Cols. 4-¾"ø Rods. ½"x4" Bands 12"c Conc. 1-2-4.	16"x16" Cols. 4-¾"ø Rods. ½"x4" Bands 12"c Conc. 1-2-4.	12"x12" Cols. 4-⅝"ø Rods ½"x4" Bands 12"c Conc. 1-2-4.			
	Cols. 36, 37, 44, 45 (Tank Cols.)	29" Oct. Cols. 8-1½"ø Rods. ½"x4" Hoop 1½" P. Conc. 1-1½-3	28" Oct. Cols. 8-1⅜"ø Rods ½"x4" Hoop 1½" P. Conc. 1-1½-3.	28" Oct. Cols. 8-1⅜"ø Rods. ½"x4" Hoop 2" P. Conc. 1-1½-3.	26" Oct. Cols. 8-1¼"ø Rods ½"x4" Hoop-2" P. Conc. 1-2-4	26" Oct. Cols. 8-1⅛"ø Rods ½"x4" Hoop-2" P. Conc. 1-2-4.	23" Oct. Cols. 8-1"ø Rods. ½"x4" Hoop-3" P. Conc. 1-2-4.	20"x20" Cols. 7-1"ø Rods. ½"x4" Hoop 3" P Conc. 1-2-4	20"x20" Cols. 4-⅞"ø Rods ½"x4" Band 12"c Conc. 1-2-4.	18"x18" Cols. 4-⅞"ø Rods ½"x4" Bands 12"c Conc. 1-2-4.		
Exterior Columns.	Cols. 9, 24, 25, 40 41, 55, 54, 53, 52 51, 50.	21"x21" Cols. 8-1"ø Rods. ½"x4" Hoop 1½" P. Conc. 1-1½-3	21"x21" Cols. 8-1"ø Rods. ½"x4" Hoop 1½" P. Conc. 1-1½-3	21"x21" Cols. 7-⅞"ø Rods ½"x4" Hoop 2½" P. Conc. 1-1½-3	21"x21" Cols. 7-⅞"ø Rods ½"x4" Hoop 3" P. Conc. 1-2-4	21"x18" Cols. 6-¾"ø Rods ½"x4" Band 12"c Conc. 1-2-4	21"x18" Cols. 4-½"ø Rods ½"x4" Band 12"c Conc. 1-2-4	21"x14" Cols. 4-½"ø Rods ½"x4" Band 12"c Conc. 1-2-4	21"x14" Cols. 4-½"ø Rods ½"x4" Band 12"c Conc. 1-2-4.			
	Cols. 2, 7, 16, 48	22" Oct. Col. 8-1"ø Rods ½"x4" Hoop 1½" P. Conc. 1-1½-3	22" Oct. Cols. 8-1"ø Rods ½"x4" Hoop 2" P. Conc. 1-1½-3	22" Oct. Cols. 8-⅞"ø Rods ½"x4" Hoop 2½" P. Conc. 1-1½-3	22" Oct. Cols. 7-⅞"ø Rods ½"x4" Hoop 2½" P Conc. 1-2-4.	20"x20" Cols. 6-⅞"ø Rods ½"x4" Hoop-12"c Conc. 1-2-4.	20"x20" Cols. 4-⅞"ø Rods ½"x4" Band 12"c Conc. 1-2-4	20"x20" Cols. 4-½"ø Rods ½"x4" Band 12"c Conc. 1-2-4	20"x20" Cols. 4½"ø Rods ½"x4" Band 12"c Conc. 1-2-4.			
	Cols. 3, 4, 5, 6, 17 32, 33	40"x20" Col. 4-1"ø Rods ½"x4" Band 12"c Conc. 1-1½-3	40"x20" Col. 4-1"ø Rods ½"x4" Band 12"c Conc. 1-1½-3	40"x20" Col. 4-⅞"ø Rods ½"x4" Band 12"c Conc. 1-1½-3	40"x20" Col. 4-¾"ø Rods ½"x4" Band 12"c Conc. 1-2-4	40"x20" Col. 4-¾"ø Rods ½"x4" Band 12"c Conc. 1-2-4.	40"x20" Col. 4-⅝"ø Rods ½"x4" Band 12"c Conc. 1-2-4.	40"x20" Col. 4-⅝"ø Rods ½"x4" Band 12"c Conc. 1-2-4	26"x16" Col. 4-½"ø Rods ½"x4" Bands 12"c Conc. 1-2-4.			
	Col. 1-8-49.	21" Oct. Col. 7-⅞"ø Rods ½"x4" Hoop 1½" P. Conc. 1-1½-3	21" Oct. Col. 7-⅞"ø Rods ½"x4" Hoop 2½" P Conc. 1-1½-3	21" Oct. Col. 7-⅞"ø Rods ½"x4" Hoop 12"c Conc. 1-1½-3.	21"x18" Col. 7-¾"ø Rods. ½"x4" Band 12"c Conc. 1-2-4.	21"x18" Col. 4-¾"ø Rods ½"x4" Band 12"c Conc. 1-2-4	21"x18" Col. 4-⅝"ø Rods ½"x4" Band 12"c Conc. 1-2-4.	21"x14" Col. 4-½"ø Rods. ½"x4" Band 12"c Conc. 1-2-4	18"x14" Col. 4-½"ø Rods. ½"x4" Band 12"c Conc. 1-2-4.			
	Col. 56 (Stack)	21"x21" Col. 8-⅞"ø Rods ½"x4" Hoop 2½" P. Conc. 1-1½-3	21"x21" Cols. 7-⅞"ø Rods ½"x4" Hoop 3" P. Conc. 1-1½-3	21"x21" Cols. 6-⅞"ø Rods ½"x4" Hoop 3" P. Conc. 1-1½-3	21"x21" Cols. 5-¾"ø Rods ½"x4" Hoop 12"c Conc. 1-2-4	21"x21" Cols. 4-¾"ø Rods ½"x4" Band 12"c Conc. 1-2-4	21"x21" Cols. 4-½"ø Rods ½"x4" Band 12"c Conc. 1-2-4	SAME AS BELOW.	SAME AS BELOW.			

Fig. 8. **Column Schedule.**

be figured according to bending moment of $WL/10$ and the load above given.

The columns, Figs. 8 and 9, were figured in accordance with the Chicago building ordinances, scaling down the live loads per square foot 5% for each floor, starting with 85% on the seventh floor, and adding the entire dead load each time. The lower columns were figured as

The retaining walls as shown around the boiler room were constructed entirely of concrete mixed to the proportion of one part of cement, three parts of sand, and five parts of gravel. The pier footings throughout the work were constructed of the same mixture. The steel used in the footings was of the high elastic limit twisted steel giving an elastic limit of 55,000 pounds, and was

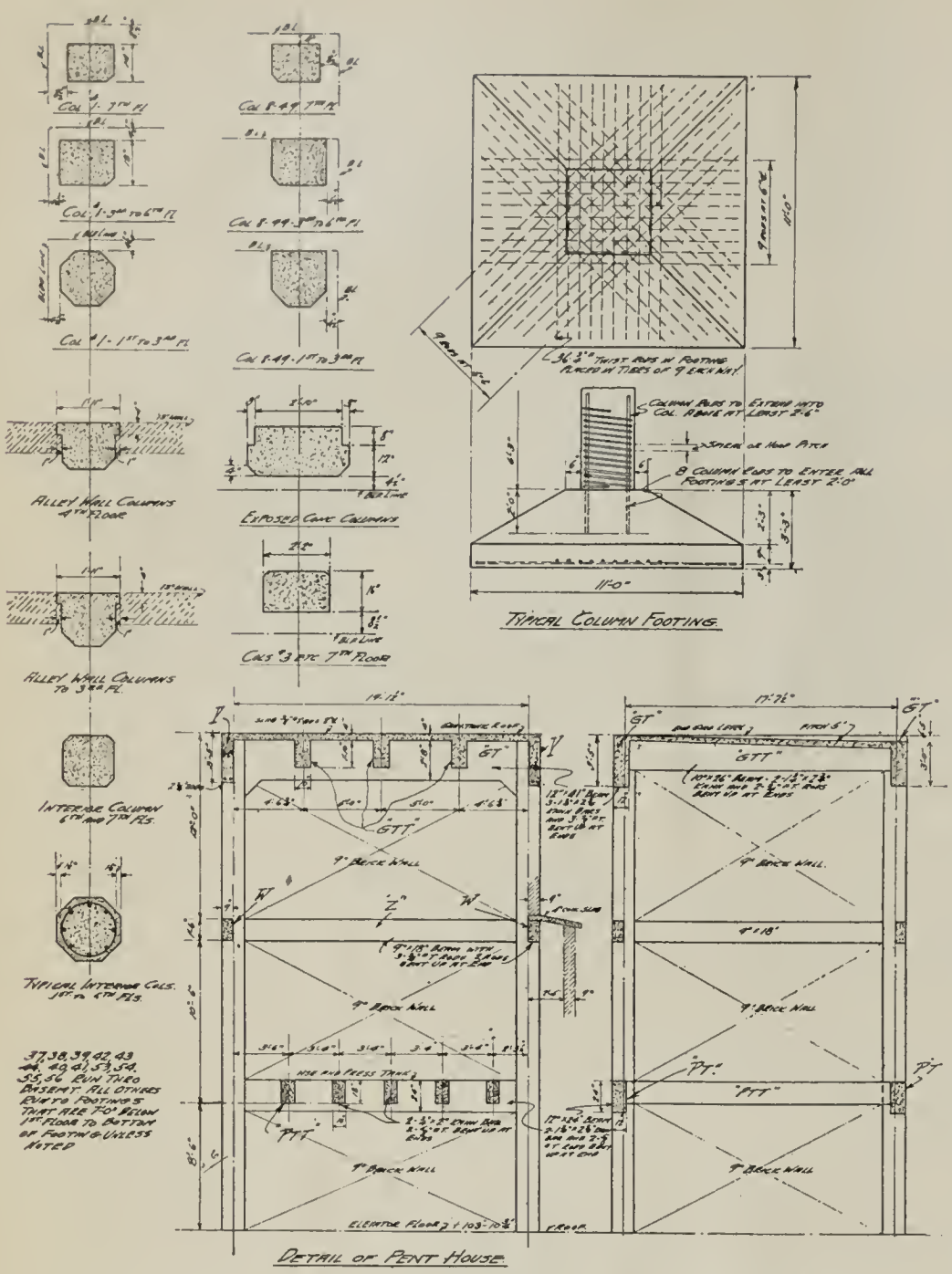


Fig. 9. Column Sections, Footings and Pent-house Construction.

tested by a reliable testing laboratory before acceptance.

The soil upon which these footings rest was of the very best blue clay entirely clear of any loam or water. Borings and tests were made before the building was erected and this same kind of clay was found continuing on to hard sand.

The reinforced concrete work of the building proper started at the top of the column footings, and continued on throughout the remainder of the building. The building is of skeleton construction, so that the columns, beams, slabs and girders were entirely constructed before any of the brick work was started.

On account of the great amount of concrete in the building, the walk space and part of the roadway on the Green street side were utilized for depositing material. On this side the mixing was done, the concrete being dumped into a large bucket, and hoisted up in a tower to the respective floor on which the pouring was being done, as shown in Fig. 10.

Run-ways were built upon the floor throughout to allow for the traveling of carts, which transferred the concrete from the bucket to the portions of the floor being poured. Before the pouring was started the necessary sleeves for heating, plumbing, and wiring and machinery hangers were installed. The rods were then wired into place and set on concrete blocks to keep them the required distance from the deck. Sprinkler hangers were installed later with an electric drill. The wiring was all run in conduit which was placed on the wood decking before concreting, and then concreted in with the rest of the work.

The concrete used in the reinforced concrete work was mixed one part of cement, two parts of sand and four parts of gravel. The gravel was preferred to crushed stone on account of the better fireproof quality.

The floors throughout were finished concrete with cement top; accordingly the finish had to be installed at the same time that the remaining part of the floor was poured.

The first three inches of floor were poured very wet in order that the concrete would fill the entire space underneath and about the rods, insuring in this way smooth ceilings, columns, and girders throughout, requiring little pointing afterwards.

The top three inches of the floor were poured very much drier and tamped so the water just came to the surface. In this way the finish could be put on nearly as soon as the required depth of concrete had been poured.

The top rods which occur over the beams were not set in place until after the rough concrete had been poured, when they were then tamped in so that the top of the rods would be just underneath the finish. The steel used throughout the floors was the same kind of twisted steel as described for the footings.

The starting of the reinforced concrete pouring was on June 22, 1911, and the pouring of the roof, excluding the gravity tank and sky-light work, was finished on September 19, 1911; thus a floor was poured every ten days, which was very good progress considering the fact that work was done through only one shift.

When the roof was ready for pouring, the brick work on the outside started at the grade line and the entire brick work was completed, excepting the tank house, on November 15, 1911, with fifteen days delay on account of rain and cold weather.

Auxiliary Equipment.

The heating plant installed is a low-pressure system with two-pipe vacuum installation. The boilers are of the horizontal tubular type with smoke furnace in accordance with the rules and regulations of the Smoke Department of the City of Chicago. The main is carried around on the ceiling of the top floor and the return is located in a concrete trench beneath the ground floor, pitching back to the boiler with the proper pitch as necessary. The building throughout is equipped with standard radiators and the heating system is designed to heat it to a temperature of seventy degrees when the temperature outside is ten degrees below zero.

Fig. 10. Building Under Construction.

There is also installed a sprinkler system in accordance with the rules of the Protection Mutual Fire Insurance Company and the Chicago Board of Underwriters. It consists of the underground work, risers, pipe-lines throughout the various floors, sprinklers, pressure tank, gravity tank, etc. The approximate total number of sprinkler heads will be 1,250, arranged in panels and installed on the "wet" system. The gravity tank has a capacity of 20,000 gallons and the pressure tank a capacity of 4,500 gallons.

The air compressor and filling pump are located in the boiler room and are electrically driven. Bells are installed on the various floors and annunciator in the boiler room, so that at any time that the heads are discharged, it is reported back into the boiler room. On account of its fireproof construction and sprinkler equipment this building has the lowest rate of insurance that the companies allow. The building was designed and constructed under the direction of Alfred S. Alschuler, '99, Architect, 1900 Steger Building, Chicago.

THE STRENGTH OF CONCRETE POLES.

Tests on reinforced concrete poles were recently conducted by the Carnegie Steel Company at its plant in South Sharon, Pa., with the view of determining the relative cost and strength of that material as compared with wood for such construction. The poles tested were 32 ft. long, 10 in. square at the butt and 6 in. square at the top. All corners were beveled and iron steps bent up ¾ in. were inserted in the forms before placing the concrete. The mixture used was 1 part of Universal Portland cement, 2 parts bank sand, passing ¼-in. screen, and 4 parts crushed limestone, passing a ¾-in., but retained on a ¼-in. screen. About one barrel of cement, ¼ yd. of sand and ½ yd. stone were used in the construction of each pole.

The reinforcement consisted of four groups of twisted rods at the corners placed not less than ¾ in. from the surface. Each group was made up of one ½-in. rod 32 ft. long, two ½-in. rods 24 ft. long and 3/16-in. rods 16 ft. long. The reinforcement was thus proportioned to the decreasing stress toward the top of the pole. Sheet steel separators held the reinforcement in place and were cut away to avoid breaking the continuity of the concrete above and below the separator.

The forms used consisted of an upper and lower section held together by bolts, the lower being a single piece, while the upper was made up of a series of units beneath which the concrete was forced. The poles thus made weighed about 2,500 lbs., or five times the weight of a wooden pole of the same length.

The tests were conducted with two concrete poles and a 32-ft. chestnut pole under the same conditions. It was found that poles of wood showed practically the same deflection as those of concrete up to 2,000 lbs., the load being applied at right angles to the pole and at the top. The deformation at 2,000 lbs. amounted to 25⅝ in., this loading being far greater than could ever be experienced in actual use. For deflections of less than 15 in. the concrete pole showed no permanent set. The test on one of the poles was carried to destruction and failure resulted at the point where the 24-ft. reinforced rods ended, the concrete being crushed for about 3 ft. above and below the break.

The results obtained showed that the cost of manufacture of such poles should be from $7.50 to $10, as against $4 to $5 for a wooden pole. The cost of wood poles is thus from one-half to two-thirds that of the concrete poles and their life of usefulness is from ten years to a maximum of twenty, whereas the life of a concrete pole is practically unlimited.

HENDRICKS' COMMERCIAL REGISTER.

The twenty-first annual Revised Edition of Hendricks' Commercial Register of the United States for Buyers and Sellers has just been issued. Established in 1891. It has been published annually since that time and is the most complete work of its kind in existence. Its aim is to furnish complete classified lists of Manufacturers for the benefit of those who want to buy as well as for those who have something to sell. It covers very completely the Architectural, Engineering, Electrical, Mechanical, Railroad, Mining, Manufacturing and kindred trades and professions. It is as necessary in the office as the rating books, typewriter or telephone. It establishes a direct link between the buyer and seller. The present is by far the most complete edition of this work so far published. The twentieth edition required 108 pages to index its contents, while the twenty-first edition requires 122 pages, or 14 additional pages. As there are upwards of four hundred classifications on each page, the fourteen additional pages represent the manufacturers of over 5,000 articles, none of which have appeared in any previous edition. The total number of classifications in our book is over 50,000, each representing the manufacturers or dealers of some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. The twentieth Edition numbered 1,419 pages, while the twenty-first Edition numbers 1,574, or 155 additional pages. Add to the latter about 230 pages of cancellations, errors, etc., omitted from the present edition, and you have a total of 385 pages of new matter, the whole representing upwards of 385,000 names and addresses. An important feature of our Commercial Register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. As an illustration—we first classify all manufactures of a particular trade under a general heading for mailing purposes; we then sub-divide each firm or corporation under as many classifications as every variety of their products call for. By this system of compiling, our book is made of equal value for either the purchasing or sales departments. No other publication embodies these features.

Again, the value of our Commercial Register for Purchasing Purposes is not confined to its complete classifications alone; it also gives much information following the names of thousands of firms that is of great assistance to the buyer, and saves the expense of writing to a number of firms for the particular article required. This latter information is also not found in any other similar publication. We also include the trade names of all articles classified in our book as far as they can be secured. These trade names appear in parenthesis between the names and addresses under the classifications where they appear. The book is revised, improved and issued annually. It is expressed to any part of the country on receipt of ten dollars. S. E. HENDRICKS CO., Publishers,
74 LAFAYETTE STREET, NEW YORK.

NEWS ITEMS.

President Morron, of the Atlas Portland Cement Company, pronounces the recent general advance in cement prices of 10 cents a barrel to $1.10, a natural result of the increased demand which has occurred in the last month and a half.

Byron D. Stockwell, Charlotte, Mich., will engage in the cement construction business and will also manufacture concrete brick, blocks, fence posts and drain tile.

Extensive Use of Concrete at Pacific Mills Print Works

The Pacific Mills Print Works, located on the south bank of the Merrimac River, at South Lawrence, Mass., is practically completed, and the extensive use of reinforced concrete in this, one of the most notable plants of the textile industry, is further evidence of the adaptability of this material for textile mill construction. The Aberthaw Construction Company of Boston executed the entire contract for the reinforced concrete work. This meant the placing of over 25,000 cubic yards of this material. The reinforced concrete construction included pouring of both the mushroom and the beam and girder systems of construction together with a modern concrete sawtooth roof and concrete coal pocket. An up-to-date contractors' equipment consisting of steel hoisting towers, corrugated iron forms, quick unloading chutes were some factors reducing the cost to a minimum.

PACIFIC MILLS PRINT WORKS.
Concrete Beam and Girder Construction.

In designing the Pacific Mills Print Works, Lockwood, Greene & Co. used several types of construction, and it should be pointed out here that the ultimate selection was influenced to a large degree by the fact that the equipment of the abandoned print works at other cities was removed to the new plant and had to be provided for. In many cases this factor changed the plans considerably.

In general it may be said that standard slow-burning mill construction was used as far as possible, the outer walls being everywhere of brick, while concrete was employed in those buildings where its distinct advantages over every other type of construction were manifest. In the departments where proof against the action of acids and dampness was desired concrete construction was adopted and it was employed also where the moisture has to be confined to a particular section and where increased overhead storage room was desired.

The piers for all of the buildings are of concrete, as are also the footings, there being a good bearing soil. The turbine house, filter building, coal pocket, and boiler house are built on Simplex concrete piles, which run down to the river mud. It was found cheaper to pile than to excavate.

The stairs in all of the structures are of concrete. The Office Building has an entrance of concrete and some of the girders are of the same material. The Printing Building has two floors of concrete extending its length with concrete beams and girders. The two basements and two floors of the Finishing Building are of concrete, the mushroom type of construction being used, but the concrete construction in the other building is the beam and girder type.

In the Dyehouse the first floor columns are of concrete, supporting the concrete floor slab. The columns of the bleachery section are also of concrete, with a sawtooth roof of the same material. The Filter Building has two concrete floors with concrete columns. In the Turbine Building there are two concrete floors and concrete incases the steel roof of the boiler house.

The coal pocket is practically entirely of concrete, while the only use of concrete in the Gray Storehouse is in the two corridors and the basement floor slab. In the Singe Building and Chemical Building concrete columns and floors are used practically throughout. The Aberthaw Construction Company executed some of the reinforced concrete work in the severe winter and the precautions taken have made possible satisfactory results.

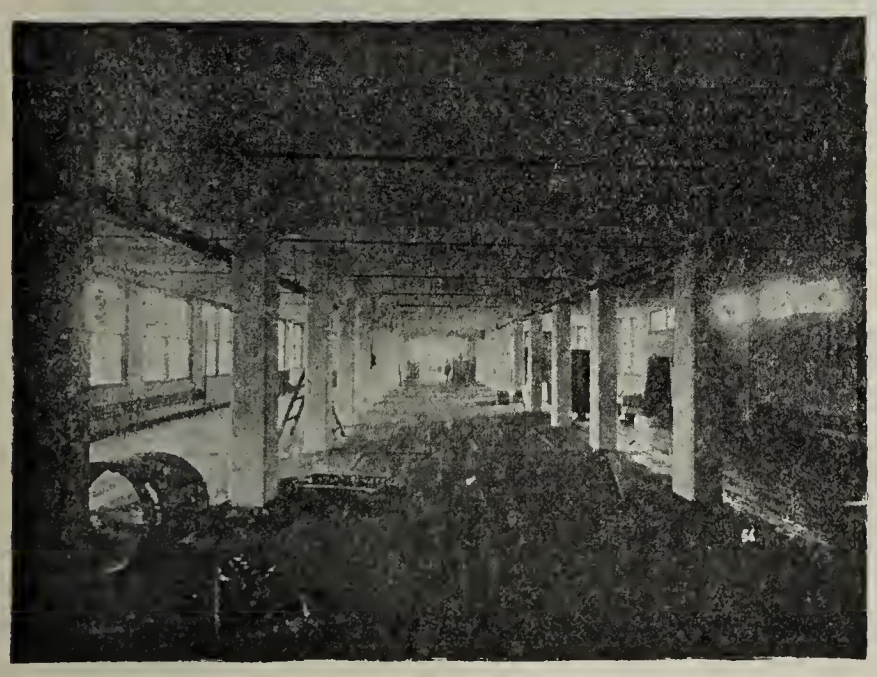
COST OF MAKING CEMENT DRAIN TILE.

H. H. Musselman, of Michigan Agricultural College, makes some estimates of the cost of making drain tile which are of much interest. In places where sand is difficult to obtain or where clay tile is extensively manufactured, the making of cement tile may

1.

not be advisable, but in sections where clay tile is not easily obtained and where sand is convenient, their cost will usually be found less than for the clay product.

In the following figures, which are furnished for estimating the cost of making cement tile, it must be kept in mind that they will be affected by local conditions in almost every case. The cost of labor, sand and gravel, kind of machine used, convenience of arrangement for manufacturing and number to be made will all affect this item. The factors which will affect the cost to the greatest degree are labor and the cost of sand laid down at the place of manufacture. The element of labor required is often neglected in



2.

making estimates of this kind, since it is assumed that at certain seasons of the year it cannot be used for other purposes.

The following figures are based on some rather short tests made by the farm mechanics department of the Michigan Agricultural College. These tile were made on a machine adaptable to both hand and power operating, the mixing being done by hand. Two men were required to operate the machine to the best advantage. On this machine from 400 to 500 tile could be made per day of ten hours by hand power and from 500 to 750 per day using small gasoline engine for power. Not more than one-half to one horse power was required to run the machine. In any case it would be of decided advantage to use power, and if a large number are to be made a mixer could be used which could be operated by power and thereby materially reduce the work connected with their manufacture. Making at the rate given above, the cement and sand have to be mixed in comparatively small batches, since no more should be mixed than can be used in a half hour.

All the figures given are for a 4-inch tile having a 9-16 inch wall. The cost of the size given should give a fair notion of the cost of the other common sizes. The proportions used were one to four of cement and sand, screened through a ⅜-inch screen.

Cost of material and labor per thousand by hand power:

4.30 bbls. cement at $1.50	$ 6.45
2.43 yards sand at $1.25	3.04
4.4 days' labor at $1.50	6.60
Total	$16.09

3. Interior View, Pacific Mills Print Works.

Cost of material and labor per thousand by engine power:

4.20 bbls. cement at $1.50	$ 6.30
2.34 yards sand at $1.25	2.93
3.3 days' labor at $1.50	5.00
1 gallon gasoline at 15 cents	.15
Total	$14.38

The rate of making in the above figures is computed at 450 per day by hand power and at 600 per day using an engine for power. It will be seen that the cost of making by engine power will run from $1.50 to $2 less per thousand than by hand. It will also be noted that the items of cement and sand might each be much lower in some localities.

GOOD ROADS YEAR BOOK.

The Official Good Roads Year Book of the United States is the title of a new publication issued by the American Association for Highway Improvement.

It contains some interesting and valuable statistics and data on road construction and highway bridges. 400 pages. Price $1.00, mailed postpaid on receipt of money order by Cement & Engineering News.

INLAND WATERWAYS.

Chicago Portland Cement Co. Makes Test Shipment Over Illinois and Michigan Canal.

Saturday, August 24, was an eventful day in the annals of the Chicago Portland Cement Co. Then, for the first time, an effort was made by the company to establish a freight route by water from La Salle to Chicago. A steam barge and tow boat, named "Peerless" and "Redwing" respectively, were commissioned for the purpose and departed with the good wishes of hundreds of Illinois manufacturers, all of them keenly interested in the experiment, and who had assembled at the starting point, LaSalle.

Chicago, a distance of 98 miles, was reached safely four days later, and the entire cargo, 1,000 barrels "Chicago AA" Portland Cement, unloaded and warehoused without mishap.

Successful in every respect, the experiment disproved the idea that the I. & M. waterway, completed as far back as 1848, was no longer navigable. The idea is now to remodel it after the Hennepin Canal, completed in the year 1907, and thereby afford manufacturers in that section of the country a water route both East and West.

One million dollars, it is estimated, will suffice to make the necessary improvements on the older waterway, and the Illinois Legislature will be asked to appropriate that sum for the purpose when it meets in January next.

LOADING AT LA SALLE, AUGUST 24.
Barge "Redwing," Taking on Cargo of Chicago AA Portland Cement at La Salle, Ill., for Transportation to Chicago.

BEST COUNTRY ROADS.

In a number of the northern states cement is beginning to play a prominent part in the making of country roads. Iowa has heretofore been a bit slow in this respect. What has been done in this state is scarcely sufficient to brag of. The few country roads in the Hawkeye state that are permanently improved have been covered with macadam or with gravel. Of the two varieties Des Moines county probably has her share, and it is understood that the Des Moines county supervisors would like to put in a few more miles of macadam pavement, but there are all sorts of difficulties which evidently cannot be overcome to the present time, and, while the board has funds that are available for the building of permanent roads, no building of such roads is being done at the present time.

To Benton county belongs the credit of doing the first permanent road work in Iowa, where the latest and most popular of all building materials, concrete, is used. A correspondent at Vinton has the following on this subject:

"Benton county now boasts of one of the first, if not the first, concrete country roadway in the state of Iowa. Contractor Hahn, of Cedar Rapids, is finishing 2,575 lineal feet of this road just across the river bridge north of Vinton.

"The land in this section is all low, and during the spring, and frequently during the summer, the river overflows its banks and covers thousands of acres. Years ago the necessity of a graded road that would not wash out was seen, and the board of supervisors had something over a mile of this road constructed of rock. In some places the road is built up fifteen or twenty feet, the base of its entire length being made up of good sized rock and the top covered with rock that was broken up smaller, but not crusher run. For a few years this road was first class. Then holes began to appear in it, and finally, through lack of attention, became almost impassable. One could hardly drive over it with a carriage or an automobile without great danger of breaking a spring, and it was hard on all sorts of vehicles with heavy loads. Vinton business people and residents north of the river repeatedly importuned the different boards of supervisors for some relief, but until recently it was denied them. Some months ago the Vinton Ad. club, co-operating with north-of-the-river residents, got busy with the board, which finally resulted in a contract being let for a solid concrete road over about a half mile of the distance. It was thought that if this road proved entirely satisfactory a layer of concrete would be put over the balance of it next year.

"The concrete road is sixteen feet wide. It is eight

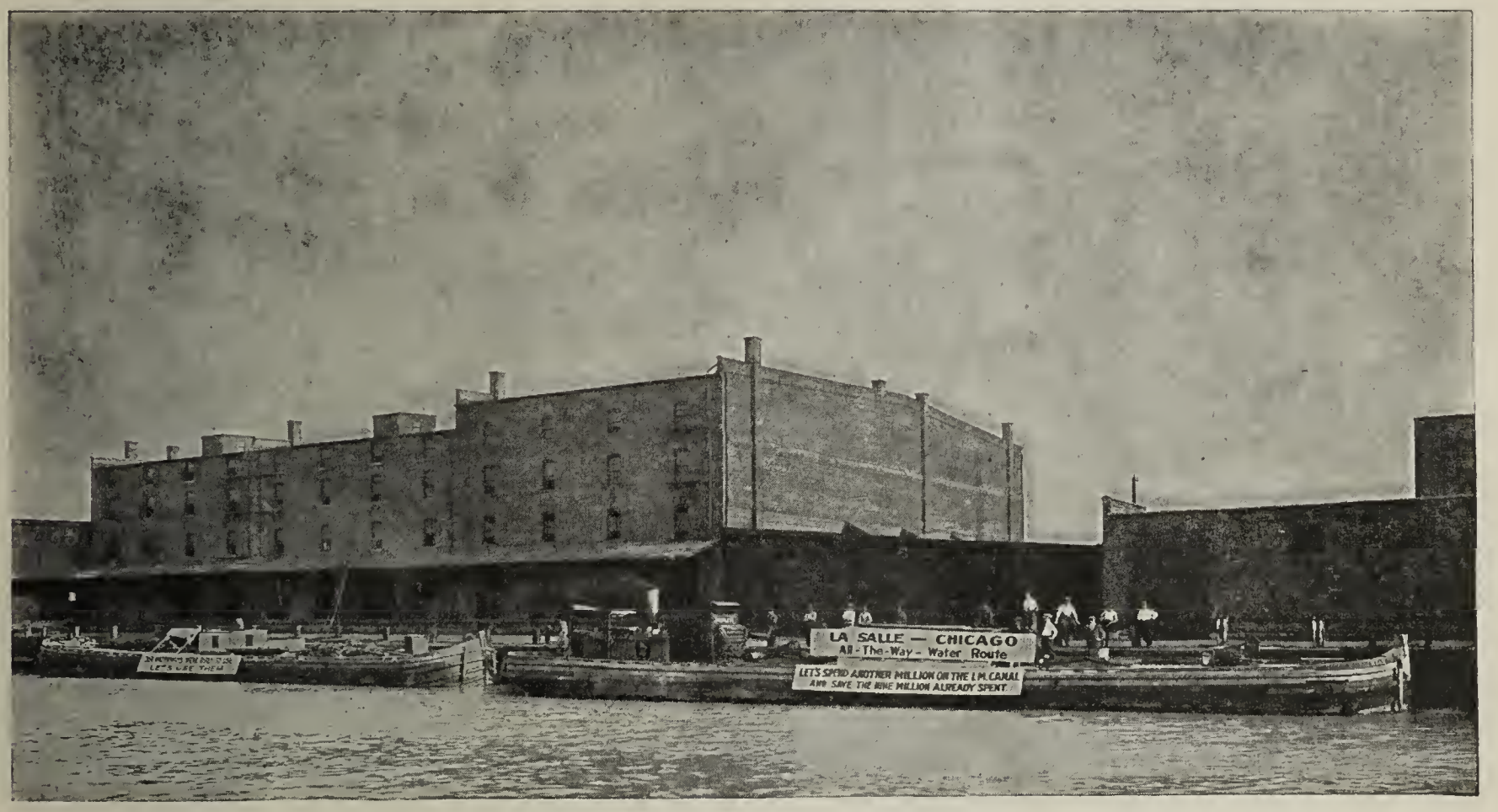
inches thick in the center, with six-inch sides and a twelve-inch inverted curb. The cost was $1.03 per yard for 1,800 feet; the balance $1.13 per yard by reason of an increase in the price of cement. Excavating cost 75 cents per yard. Expansion joints are placed every thirty-two feet and contraction joints every thirty-two feet. It is the finest roadway in the county and will more than likely act as an inspiration, and without doubt in the next ten years a large amount of concrete roadway will be built in Benton county.

"The contractor having charge of this work was also engaged in laying concrete paving in Washington street in Vinton, but withdrew his entire force for this work in order to finish up the north of the river road so that farmers in that vicinity could have a good road for hauling loads to the Vinton canning factories, which are making preliminary runs to-day."—Burlington News.

THE REMEDY FOR DAMP WALLS.

A means of preventing the penetration of dampness and water through structures such as foundations, cellar walls and floors, tunnels, dams, reservoirs, swimming pools, and other concrete work, has often proved a difficult problem. Concrete is porous because of the voids between its contents. Under a glass a fresh surface of fracture shows that the pieces of stone and sand are smeared over with a very thin coating of cement wash with considerable remaining voids. Through these voids water will pass by gravitation and capillary attraction. To make the concrete waterproof, two principal methods have been tried. One is the filling of the mass throughout with a non-porus substance, or the treating of the surface so as to make it watertight. The objection to the surface coating is that it is easily broken or rubbed off in spots and is too weak to be serviceable as a waterproof coating should be. It is not satisfactory to waterproof the mass of concrete in such a way as to leave this important property at the mercy of continued watchfulness and renewals. A satisfactory waterproofing must be as durable as the concrete itself.

A waterproofing compound which is mixed with and becomes an integral part of the structure is known as Ceresit, a cream-white paste of about the consistency of butter. Ceresit paste is simply added to the water used in mixing the mortar or concrete and penetrates with the water to all parts of the concrete or mortar, assuring a permanent waterproof and damp-proof structure. Among the properties of Ceresit may be mentioned that in addition to preventing penetration of any moisture whatever, it does not affect the original strength of the cement, and is so inexpensive as to make it a means of real economy. The many structures in which it has been used are continual evidence that it prevents the penetration of water, even under heavy pressure, as in dam, reservoir, bridge and similar work.



DOCKED AT CHICAGO, AUGUST 28.

Barge "Redwing," with Cargo of Portland Cement, in Tow of Steamer "Peerless," Docked at Chicago, August 28. Trip of 98 Miles Made Without Mishap, Through Old Illinois and Michigan Canal.

AKME SYSTEM REINFORCED CONCRETE.

As the Chicago building ordinance, passed in 1910, did not cover girderless floor construction of reinforced concrete, the building commissioner, Mr. Henry Ericsson, recently appointed a commission consisting of Prof. A. N. Talbot, University of Illinois; Dr. W. K. Hatt, Purdue University, and Mr. L. E. Ritter, consulting engineer, to investigate and pass upon the Akme system of the Condron Company, Chicago, for the guidance of the city building department. Design standards were formulated. At present there is being erected in Chicago on this system: A grocery warehouse and box factory, 270,000 sq. ft. of floor surface, for Sears, Roebuck & Company, Mr. Geo. C. Nimmons, architect; a factory, 220,000 sq. ft. of floor surface, for the Illinois Wall Paper Mills, Mr. C. A. Eckstrom, architect; offices and warehouse, 100,000 sq. ft. of floor surface, for the American Book Company, Mr. N. Max Dunning, architect; offices and factory, 60,000 sq. ft. of floor surface, for the International Register Company, Mr. Myron Hunt, architect.

Equipment at The New Cape Girardeau Cement Plant

At Cape Girardeau, Missouri, the recent construction and equipment of a cement plant is of interest. The steam plant is equipped with four 350 H. P. Water Tube Boilers. In the power plant is one 800 K. W. Westinghouse, A. C. generator direct driven from a high speed double flow Parsons Turbine. All the machinery is driven direct from Westinghouse motors.

Mr. A. W. Harrison, traffic manager of the Cape Girardeau Portland Cement Co., advises us that the following equipment was furnished the new plant and is being very successfully operated: Griffin Mills, by the Bradley Pulverizer Co., Boston, Mass.; Fuller Mills, by the Lehigh Car Wheel and Axle Works, Catasauqua, Pa.; Williams Mills, by the Williams Patent Crusher & Pulverizer Co., St. Louis, Mo.; Kilns, by the Chalmers & Williams, Inc., Chicago Heights, Ill.; tube mills, by Bonnot Co., Canton, Ohio.

WHERE EAGLE BRAND PORTLAND CEMENT IS MADE.
New Plant of the Cape Girardeau Portland Cement Company, Cape Girardeau, Mo.

Griffin Mills, made by Bradley Pulverizer Co., Boston, Mass.; Fuller Mills, Lehigh Car Wheel & Axle Works, Catasauqua, Pa.; Williams Mills, Williams Patent Crusher & Pulverizer Co., St. Louis; Kilns, Chalmers & Williams, Chicago; Westinghouse Turbine Engine and Generator, Westinghouse Machine Co., East Pittsburgh, Pa.; Westinghouse Motors throughout, Westinghouse Electric & Mfg. Co.; Tube Mills made by Bonnot Co., Canton Ohio.

The conveying and transmission machinery is of the latest pattern. The entire length of the six belt conveyors is about 450 ft., ranging in width from 18 in. to 24 in. Twenty-four hundred feet of 9 in. and 12 in. screw conveyor were supplied. Elevators are both of the chain and the belt and bucket type. About fifteen separate elevators were used, varying in height from a few feet up to sixty.

The capacity of the plant is 1,500 bbls. of cement per day. Shipping is done by way of the Mississippi River and the Frisco Railroad. Raw material used is a good quality of rock and clay which is obtained in that immediate vicinity. The product of the plant is the best grade of Portland cement and the company is prepared to supply the same at all times in Southern Missouri, Arkansas, Louisiana, Eastern Kentucky, Eastern Tennessee, Eastern Mississippi and Southern Illinois.

R. J. Kellogg, who has been prominently associated with the cement industry, superintended the construction of the plant. The officers of the company are W. H. Harrison, president; M. E. Leming, vice-president, and F. L. Griffiths, secretary.

BIG CONCRETE COAL CHUTE FOR SOUTHERN.

Ground has been broken for the erection of a mammoth new concrete coal chute for the Southern Railway Company in Spencer, N. C.; also for a new and modern sand plant and new cinder pits in the Spencer yards. A large force of men will be placed on the job at once and the work will be pushed to an early completion.

The coal chute will be constructed of concrete, will be about 1,000 feet long, 35 feet high, and will have a storage capacity of 600 tons in pockets, on top the chute, and 10,000 tons on the foundation floor. Provision will be made to unload cars in hoppers. The coal will then be conveyed to the chute proper by motor driven machinery with an estimated capacity of 1,000 tons per day. There will be four coaling tracks available for locomotives and owing to the ingenuity displayed in the construction of the plant the whole will be manned by two men, who will be able to coal 100 engines each day.

USE OF CONCRETE ON THE FARM.

Each year concrete is more extensively used on the farm—for foundation walls for building, for cisterns, for silos, for stable floors, for walks about the house, for porch steps and numerous other purposes. It is a step that has durability and attractiveness to recommend it. When properly put down, concrete proves to be both economical and permanent.

VAPOR CURING.

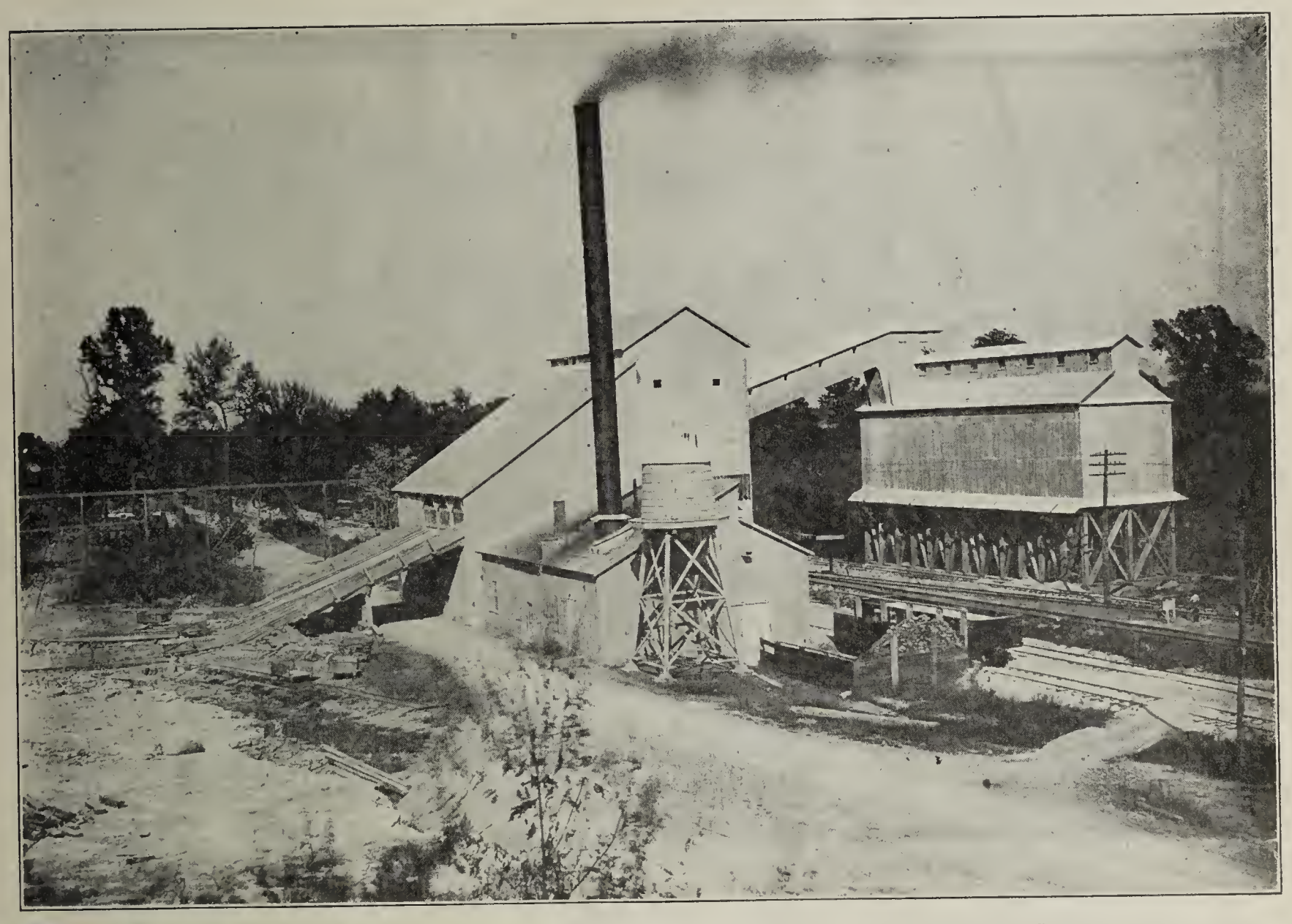
One of the most interesting and valuable features of the block making systems being installed by the X-L Concrete Stone Machine Company is the simple, efficient and economical method of curing the product. This company is not satisfied to simply sell a man a machine and let him go ahead with his block making any old way. The officers of the company know that they have a machine which will make a block highly satisfactory in every way, and for the sake of their own reputation, as well as the reputation of the industry in general, they are anxious that each man who has one of the machines shall turn out the best product of which the outfit is capable.

They realize that a machine-made block cannot be given sufficient water at the outset to carry it to the final set, so that the sooner after it is made, that additional moisture can be introduced, the better. With ordinary methods of sprinkling, water cannot be used on the blocks for some hours after they have been molded, because of fear of damaging them. In steam curing it is the usual practice to fill a curing room before the steam is turned on, so that some of the blocks are several hours old before receiving additional moisture. And at any rate steam curing means a considerable investment for plant, which manufacturers do not always care to incur.

The method used by the X-L Concrete Stone Machine Company is what is known as the vapor method. It is simplicity itself, consisting merely of a nozzle for attaching to a hose or standpipe which transforms a stream of water into vapor. This is accomplished by a double nozzle, the two parts being so placed with respect to each other that the two streams of water shoot into each other, reducing the entire amount of water to vapor, which floats in the air and saturates it. This moisture is taken up by the blocks and furnishes the water necessary to complete the crystallization.

TESTING A NEW EXPLOSIVE.

F. M. Marshall, the inventor of a new explosive, gave an interesting demonstration of the blasting material before a committee of Chicagoans at the quarries in Joliet, Ill., recently. Mr. Marshall tossed a long yellow stick of the explosive on a rock. He then produced a revolver and riddled the stick with bullet holes. Gathering some of the remnants together, he hurled them with all his might against a stone wall. Then he took other portions of the explosive and spread them over a flat rock. He then picked up another rock and ground the pieces between them. By this time everyone in the committee expressed a doubt that the material would explode under any circumstance. Marshall laughed and again gathered the crumbs together and with several new sticks dropped them into four holes that had been drilled into the top of the limestone ledge. It was a part of the quarry where the stone was the hardest. He then adjusted fulminating caps and wire and the whole party retired to shelter. When all were free from danger the inventor touched a button and a cloud of dust and stones arose from the points where the "Amerite" was buried. An instant later there was a dull roar as 100 tons of rock crumbled off the edge of the cliff and rattled down into the pit of the quarry. Later Mr. Marshall took the remaining sticks and built a fire in front of the quarry office. He held the stick in his hand while he ignited the end of it in the fire. It burned with a bright flare, but without concussion.



Rock Crushing and Storage Plant of Cape Girardeau Portland Cement Co.

Annual Meeting of Ohio Quarrymen

Discussing Road Building, Demurrage Charges, Etc.

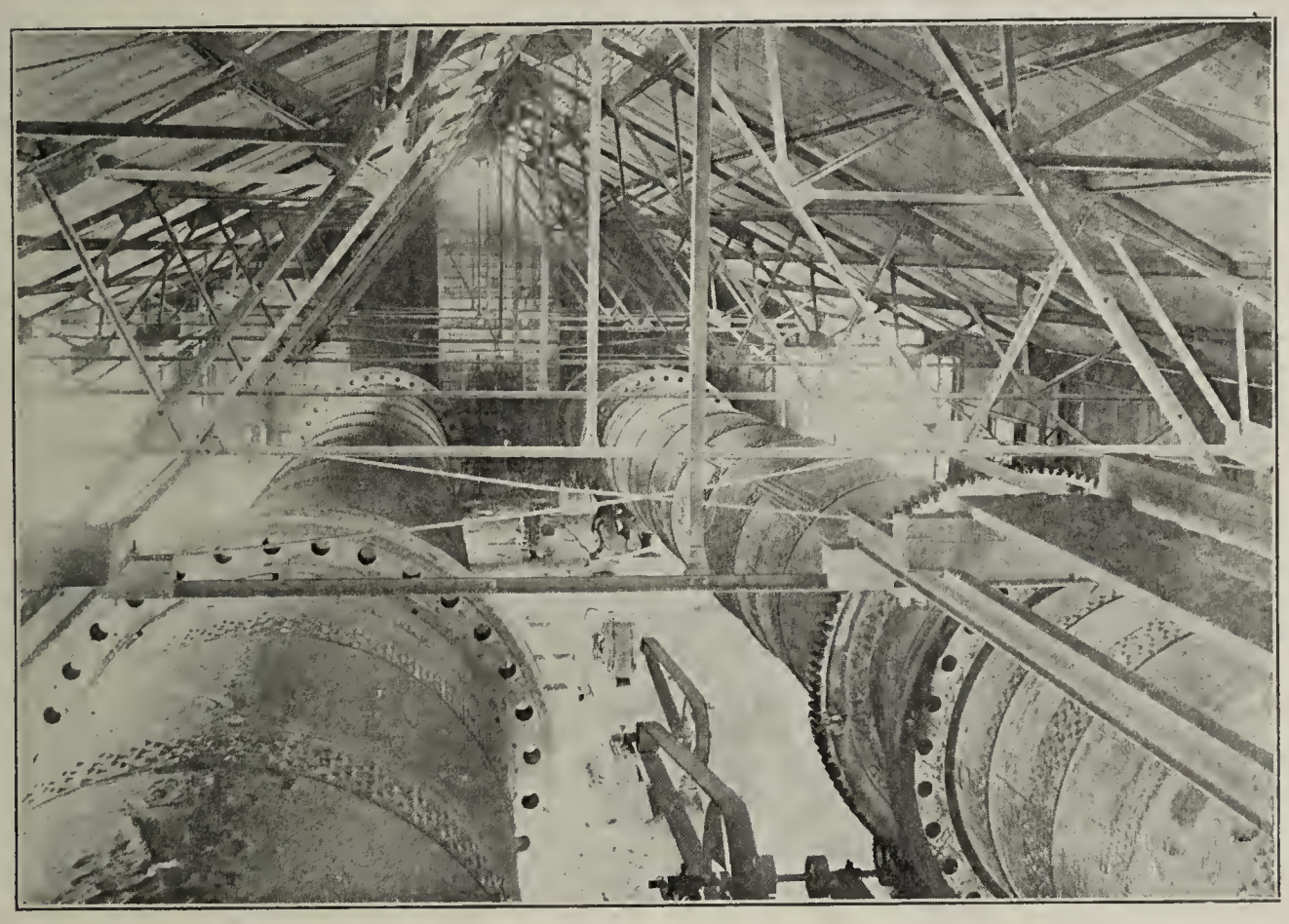
Geo. B. Christian, of Marion, Ohio, the president, called the meeting to order with a sketch of the problems that confront the road contractors and quarry operators of Ohio. More than $10,000,000 of invested capital is represented in this meeting and that is the exponent of one of Ohio's important industries. Ohio is essentially a manufacturing state. She is supported by her industries, which have grown in magnitude until her agricultural products have become insignificant. He compared Ohio to Iowa, a sister state having about the same number of square miles but more productive of agricultural products and more essentially an agricultural state. Ohio could never occupy her position without the industries that have been built up in her midst, and we have always had plenty of tinkers down at Columbus in the political field to discuss the referendum and recall and all manner of isms and doctrines, but what you and I want to know refers to two other R's, namely, railroads and what railroads want ballast, is the grand question with most of us. The same lawmakers have discussed these philanthropic propositions to great length but never get down to practical questions when they know it. They turned us down in the simple practical proposition of adopting a standard unit of measure of a fair and honest observation of crushed rock delivered on road contracts. They learnedly discussed the use of convict labor on road work without any practical knowledge of the fact that roads are now built with improved machinery with very little labor other than that of skilled labor, which is required to operate more or less complicated machinery. They have agitated the equipment of state quarries for the production of crushed rock for road purposes upon the supposition that anybody can run a crusher plant economically. I am satisfied that any of us can furnish rock in the proper sizes for building roads just as cheaply as it will cost them to produce the same material in a quarry operated by state officials. In fact, we can sell it to them, and are selling it to them, for less than they can produce it under such conditions. It is a fact that our line of business suffers more from unjust competition than any other, and with the Valentine law and the Sherman we are unable to discuss the matter of price and cost with one another without being outright lawbreakers. Everybody knows that the milkmen have to have an agreement as to the price of milk which they supply. They would have us believe that the saloon keepers haven't got a right to all charge the same price for a glass of beer or that the barbers have no right to quote a uniform price for a shave. In fact, there is no kind of a commodity produced or service rendered that does not need an agreement fully understood or expressed as to what such commodity or service is ordinarily worth, that people can base their calculations on what their daily and regular expenditures are going to be. It is a matter of fact that our daily newspapers are rotten in the attitude which they assume towards the business interests of the state and country at large. Every man has to admit that when hay is at $21.00 a ton, the price of butter has got to go up to 60 cents a pound. Yet, if two road contractors get to talking about the price of producing rock in their quarry, it is a restraint of trade. As a matter of fact, stone is sold in Ohio 35 to 40 per cent cheaper than in any other state, and it is my honest opinion that we frequently furnish the material below the cost of production. Now, we are essentially road builders and we want to secure state and government support of the roads, and we want to have an appropriation and the actual construction of the roads properly distributed. The

Clinker Storage at the Plant of the Cape Girardeau Cement Co. Where the "Clinker" Is Cooled Before Grinding. Traveling Crane and Grab Bucket Is Employed for Handling Material.

constitutional convention now in session wants to recognize the facts that bear upon the shape and conduct of our business. We all want and need prosperity and the upbuilding of business, and we want those men who are working on the new constitution to use their reasonable intelligent endeavor to increase our prosperity by giving us the right kind of laws. We hope to have an amendment of the Smith law so as to provide for repairs of roads that are made and thus preserve permanently the improvements that are being made. Those men who are working on the new constitution can and should so amend it as to provide for the future of the road proposition in the state, and the maintenance is quite as important as the building of roads in the first place.

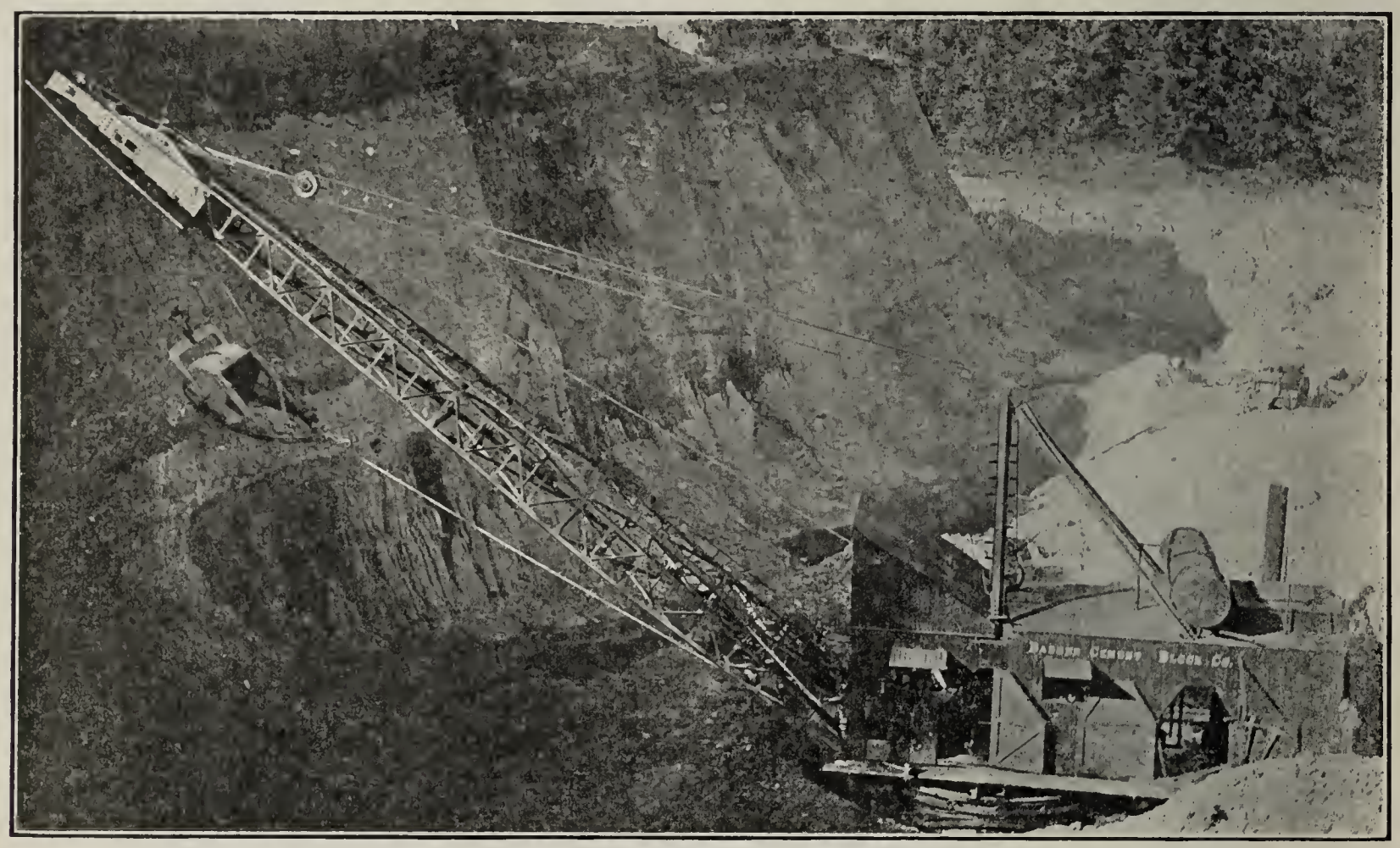
I see that Mr. Taylor has arrived and, as he will only be with us this afternoon, I will get him to now take the floor. Mr. Taylor is the representative of the Good Roads Association in Ohio. He is the exponent of all of the energy and all of the concentration that has been brought to bear on the road question, which is of so much importance to all of us, and it is up to us to stand together in these matters. I have the honor of introducing Mr. Taylor.

Mr. Taylor is gifted by nature with the kind of eloquence that electrifies his hearers. He began with the expression, "Fellow Highwaymen; I realize that there is no need to talk to you stone men upon the need of road construction. I had assumed that the stone business was a very profitable one and I am astonished to find that no money has been made in the last year. It must be your own fault for you are producing an indispensable product for the construction of an improvement which can be not long dispensed with or postponed. It certainly looks to me as if it is time for you to hold an executive session and fix things up so that you will understand the problems of your business. I believe, and every other sane man in Ohio believes, that you and every other business man is entitled to reasonable profit in your business and it is so understood. The Good Roads Federation, of which I am a representative, has been said to be composed of road fools who are not interested in any way with road-making materials, but who give their whole efforts and power to the task of securing appropriations and contributions for building roads. We know what the drawbacks are in getting a road built in Ohio and just how disappointing the appropriations and contributions are in these matters. The managers seem to think that any time is good enough and they keep putting it off from day to day. Road building is one of the most ancient as well as most civilizing efforts in the human family. The road builders of Carthage and Rome made possible the movements of those armies which carried the early civilization to the uttermost parts of the continent of Europe from which our civilization has been derived. It has been conservatively estimated that $2,000,000 of American money has been spent in Europe by tourists because they have found good roads throughout the continent. These very people, for the most part motoring cranks, have been driven away from America on account of bad roads and impossible motoring conditions which exist here. Throughout Europe they have, for centuries, been building and improving their roads. The cost of hauling farm products over American roads, taking a grand average, amounts to 23 cents per ton, taking short hauls and long hauls into consideration. On the same basis, in England the cost is 10 cents per ton; in France, 9 cents per ton, and in Germany 8½ cents per ton. This makes a tremendous difference in the cost of living and it can be attributed to no other cause than the difference in the condition of the roads over which food products have to be hauled in this country, for it is a well known fact that the American farmers have better equipment in wagons and teams than either the English, French or German farmers, and the difference is in the roadbed itself. It makes me tired to meet farmers who are reading magazines about things miles and miles away, while right in front of their doors there is a great question to be settled for the good of their homes in the present and for the future and which amounts to a very profitable and immediately collectable asset in the value of their farms. It is a matter of fact that we dump $400,000,000 every year into the mud by having soft roads at the



Kilns at the Cape Girardeau Cement Plant, Furnished by Chalmers & Williams, Inc., Chicago Heights, Ill.

very time of the year when we need a good hard pathway to the markets, and this $400,000,000 is added to the cost of living and calculated in the price that we have to pay for butter and eggs, meat and potatoes, which has come to be the crying complaint of all the people. You have not been taking the proper interest in the application of your product to road building. When you sell rock delivered on the road, you have been letting somebody else attend to your business by prescribing just how you shall use it; just how you shall handle it and just how the road shall be made. I believe that the men in this room know more about the actual practical application of macadam to make a good road than all the legislature that can be assembled at Columbus. If anybody needs a school it is the crushed rock producers of Ohio and the so-called road experts. Public sentiment is the final law of this land and we can get good roads by legislation if we secure the unbiased opinion of the public and the public interested in the proposition. I don't think there is difficulty about national aid in the road proposition. The old Cumberland and the National road were started in the early part of the 19th century under the constitutional right which the government has to construct post roads. No such right has been taken away from the government and it still exists. The government has just as much right today to contribute to the construction of roads for the superior service of the rural free delivery as it ever had to build post roads when all of the mail was carried by the stage coach. All of the roads that are being built in the Philippines, in Porto Rico and Alaska are being built by government aid and nobody questions its constitutionality. One might just as well question the constitutionality of the large expenditures for the Panama Canal, for a canal is nothing more or less than a water roadway and the wagon road to cross the canal zone was one of the first roads for the government to make. There was also $10,000 to make an experimental or sample road in the District of Columbia, and by the suggestion of President Taft this road was laid so as to connect the gate of Chevy Chase golf club with one of the Washington boulevards. I do not consider that nationally it was a very complex problem, except that it is offered by people who are not in favor of good roads to find the objection and difficulties. The trouble with the road laws of Ohio is that we have too many road laws so that we cannot tell when they are off and when they are on. If you can get the Brown law and read it, you will find that it is perhaps the best road law that we have, but it has not been put in operation in more than a few counties. I believe that if you practical road builders would study the Brown law you would think more of it. I agree with what Colonel Christian has said, that the new constitution, which is now being put into shape by the officers at Columbus, must be shown how to provide for better roads. It is a campaign for the consumers as well as the producers. It is a campaign which we must all undertake for ourselves and for our neighbors. It is a campaign for the general uplift of every citizen. I could talk on till morning, but I know very well that every point in favor of good roads that I could make is already an old story with you men of this road builders' organization and in closing I want to exhort you to do all you can to back up the Goods Roads Federation in the campaign to give our law-makers the clearest and best information in the most unbiased and fair way upon the subject of good roads of Ohio, which is today in my mind one of the greatest needs of all the people in the state."



Drag Line Excavator, 1½-Yard Bucket, 60-Foot Boom, in the Badger Cement Block and Gravel Company's Pit, at Milwaukee.

(Prolonged applause.)

Colonel Christian expressed the appreciation of the club to Mr. Taylor for his eloquent address and remarked that 42 cents per ton was the average cost of road rock in the state of Ohio during the year 1911.

Mr. Hatch said: "It appears to me that we have got to have a publicity campaign in order to educate the public as to the full value and real cheapness of macadam roads. We have got to support such a campaign and build up our business of road contractors in place of cutting and slashing at one another independently. All this bunk about the automobile cutting up the roads is carefully edited and published by the brick

organization, which wants to sell its seconds for road building at $1.85 per yard, making a road cost $103,000 for eight miles of road. All of this agitation is the deftly drawn up and carefully expressed advertising of the brick interests and other interests who manufacture road materials other than old-fashioned dependable macadam, which never has a word said in its behalf, but which is always held up for the comparison of other materials to take a shot at. It has come to my knowledge that cement manufacturers and the concrete interests in general want to get busy in the good roads game and they want to use the product of our crushers. I read in Rock Products and elsewhere of the progress which has been made in this direction, and it has been demonstrated that we can put in a good hard concrete base, using crushed rock in concrete, that will beat any brick road that ever was laid, and it is cheaper in the upkeep as well."

Mr. Moores: "I like that suggestion and think that perhaps we could work out some plan, as the brick men work, in this matter of beginning a campaign of the merits of macadam road to the powers that be. I was at the Good Roads Federation in Richmond the other day and it is worthy of comment here that Ohio was better represented than any other state."

Colonel Christian remarked: "When it comes to a comparison between the macadam road and the brick road it is easy. It costs just about 50 cents per square yard to make a good macadam road and $1.85 per square yard to make a brick road, the relative values of the finished article in both cases being about the same.

"Mr. Ireland said that Van Wert county has 700 miles of rock roads. More than any other county in Ohio. The main road is sixty feet wide and ten inches deep. The laterals are eight feet wide and ten inches deep, and all of the rock used is two-inch mill run rock. With all this mileage of roads there is no available appropriation for repairs, and it naturally gets worse and worse from year to year."

George B. Christian, Jr., said: "I have done some work down on the old National road and find that a good road. The new work that we put in is to my way of thinking something like the best road that was ever built in Ohio, and it is due to the fact that all the work was put in on tonnage basis, that is, the contractor delivered his rock and was paid by the ton. I consider that poor roads are made in the first place by trying to make one yard cover what a yard and a half ought to cover. The new road in Franklin county, over the old National Pike, was made in two layers. We put in fine stuff on the bottom and coarse on top. The tar was poured on in tanks and put on liberally, after which just enough fine screenings were put on the surface to keep the roller from sticking. The tar that was spread on the surface certainly aided materially in making the roller work to the good. This road is 16 feet wide and the estimated cost is $80,000. We used tarvia at 10 cents per gallon."

Mr. Moores remarked that down in Cincinnati they were going to have a whole lot of repairs with tarvia roads as in many places it is getting skinny in spots.

The hour being late Colonel Christian suggested that a motion to adjourn for the day would be in order.

The evening was spent in a grand theater party, which was organized by George B. Christian, Jr., who had secured the passage of a motion, early in the day, for the club to buy the theater tickets. It was a vaudeville performance, and most of the members were well behaved in the crowd, including Lawson Moores and Dennison, and everybody enjoyed the evening immensely.

Demurrer Charges.

As usual the delegates were a little late in taking their places, but Colonel Christian started things off with a rush at that number on the program entitled, "Are Present Demurrage Regulations and Charges Equitable and Just—How Shall They Be Amended?" He explained that the various railroad representatives in the city of Toledo had been invited to be present to take part in this discussion, and that they had promised to attend, but in looking over the audience it was found that none of them had as yet put in an appearance. Colonel Christian remarked that the railroads were an essential part of modern commerce, and they should be backed up in all the good things that they do, but not necessarily in every ruling that they make. I am not one of that class who consider that nothing that a railroad can do is right. I consider that a reasonable prosperity of the railroad interests in general, is essential to your business and my business. The trouble is that the railroad management do not believe in the representatives of business men, and the business men, as a rule, do not believe the statements of the railroad management. In these times every political demagogue has got his knock at the railroad in order to sharpen his political axe. It occurs to me that the business men who are shippers ought to get together with the railroad people and co-operate with one another so as to be reasonable on both sides. Now, the treatment of this demurrage proposition is worked out entirely on the basis of distrust, and the way it has been applied to the stone business particularly, the burden has become so great as to eat up all the profits of the business in some cases. This year we have all realized that it is impossible to haul crushed stone on the right of way of the railroads after a heavy rain. Here is a place where we have a right to demur over a condition in which we have no control nor has the railroad. Certainly somebody has authority to bring this demurrage question to a fair basis. In order to work it out the railroads must be fair and give just what they demand. We should take the position that we want to get a square deal and give a square deal and if they have a right to demur at our unloading proposition we have the right to demur at their lack of deliveries. I once had to ship a car of stone per day for fourteen days to one customer and he never got a car for two weeks. The railroad agents of country stations particularly have no power of discrimination as a business man and no contractor can exist when his business is held up by rigid rules that are written in the office somewhere which do not apply to local conditions at all. It occurs to me that what we want is credit memoranda for prompt unloading which can be applied on demurrage bills when conditions make prompt unloading impossible. I would suggest that our representatives get together with the state railroad commissioners and work out some friendly, fair and equitable basis on which to proceed, and I know that, as a rule the railroad men are good business men and would hail with joy any measure that will permanently improve their business.

George B. Christian, Jr., said: "I can see that nothing is the matter with the rules of demurrage at present. The trouble is, as a rule, with the crusher men. I think that the rules the railroads have made are very equitable when properly administered. They have got a credit memorandum system and the way I see it, the particular needs of our business is to have an explanation, honestly expressed, so that the railroads understand what we need to enable us to do more business and put away more money. I do not

think there is any doubt of the result of such an undertaking if it is properly managed."

Mr. Ireland said: "I understand that there is a bureau, composed of representatives of all railroads and that they meet occasionally and have to draw the line somewhere on demurrage matters. On the average plan of demurrage charges, there has never been any account taken for rain or mud, and the unfair part of the present plan is the case where fifteen days of impossible haul occurs and then it operates so as to punish the innocent man. I suggest that we draw up resolutions, as one of the industries of the state, and take the matter up intelligently for the attention of this bureau, and I think we will get results. We must have a definite line of action so that we can get ourselves properly expressed.

On motion this matter was referred to the Executive Committee to provide for such action and carry the same to the attention of the parties at interest.

Mr. Ryan, speaking, suggested: "Why should it not be fair to settle demurrage on the basis of one year's operations? If I get credit for unloading, when I do it in an hour or two after delivery of the car, the railroad ought to pay me demurrage the same as I have to pay them. I think if we get a law to get the co-operation of the people, it would pay. I consider that the demurrage law is radically wrong, although I have never paid a dollar."

Colonel Christian: "I have been a producer and contractor for twenty-five years. The suggestion that we go to the railroad people with equitable plans is a good one, and I am sure that they would meet us half way and treat it as a business proposition. Our demands must be just in the first place, and if we insist on them, we are sure to get what is right. I believe that we can get a division of rates where the haul is over more than one road if we can put a clear and distinct plan before the railroad people, because it would give them a great deal more business, and could be fairly done. If we fight for a square deal and no more we are sure to get it, and this can be done by establishing a balance sheet to give and to take. We are certainly entitled to credit for cars unloaded ahead of time to apply on the unloading of cars where we are delayed in the unloading. The committee who takes charge of this must lay aside all prejudice and I want our Executive Committee to go before the Commission with a well considered proposition, and I move that a committee of five be appointed to undertake the matter."

The motion was duly seconded by Mr. Quilter, of the Brokensword Stone Company.

George B. Christian, Jr., said: "I do not think anything unfair ever existed. It is our own fault that our kind of needs have been misrepresented. The present demurrage rules have been forced upon the railroads by the Ohio Shippers' Association. It is the local haul of the road contractors that has not been taken into consideration. Beyond question, the railroads are in favor of good roads and are disposed to do all they can to intelligently assist the matter and make more money out of their own business thereby."

Mr. Ryan: "It is not the big railroads nor the big railroad men, but it is the small roads that the contractors are up against in these demurrage matters. It looks as if they try to make their profit out of the demurrage collections."

This closed the discussions and the motion was unanimously carried.

The next measure taken up was the consideration of the "Smith Tax Law; What Amendments Are Necessary for the Benefit of Road Construction and Repair?"

Colonel Christian said: "The Smith bill has been much commended both throughout the state and nation, but, as a matter of fact, it does not just work out like it was supposed to do. In the adjustment of tax valuations of the state, it shows that the people of Ohio have been honest in making out their tax duplicates, so that the collections under the Smith law were not as much as were expected. I have been a farmer all my life and I never saw a farmer who paid his just share of taxes. I am willing to offer a prize of $50.00, to be paid to any church in Marion, if any farmer paid his just taxes. Some farmers have doubled their taxes. The railroads are certainly taxed plenty, and this Smith bill, to my notion, wipes out the democratic form of government and erects a county and state czar, respected in each county. I want the state eliminated in the matter and have each county attend to its own business. I observe that under the Smith bill every kind of improvement has been stopped. It is good in its meaning but it is crude, and the worst feature of all is that the Smith bill won't let repairs be made and gets away from the main issue of home rule in road building."

Mr. Quilter: "There seems to be plenty of road petitions and except in several injunction cases, I think there is going to be good business in road building this year."

Mr. Reinheimer remarked that in small townships the Smith bill does not hurt, but the labor proposition is bad where corporations and towns are in the calculations. Some township officials would increase their repair appropriations if they could.

Colonel Christian: "The repair bill of some of the big counties is something awful."

Mr. Hawblitz: "In a number of the counties where I have been this past year, they have been up against the one per cent limit. The rural vote invariably turned down the petitions in Lucas county. There are 125 miles of brick roads in Lucas county. In Cuyahoga county brick roads are built exclusively and there are 200 miles of them."

George B. Christian, Jr.: "I consider that the Executive Committee ought to take up the matter of road materials with the constitution, which is now in session. They might be able to get something through."

Mr. Moores: "The Good Roads Federation is supported by voluntary contribution. The brick men gave them $4,000 as an association; the asphalt interests, $1,000. The Automobile Association also gave liberally. Their campaign is going in on the square without troubling with the liquor proposition or any other side line, and I feel that this association ought to support the Good Roads Federation in so far as they can."

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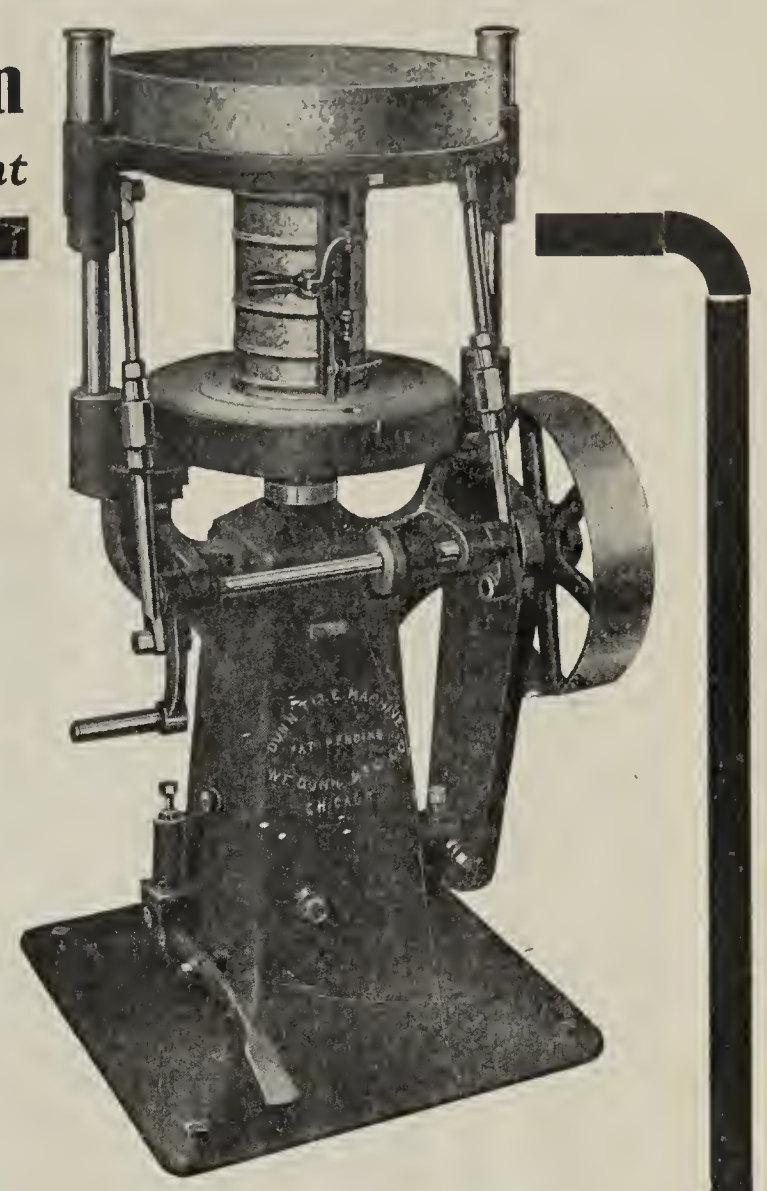

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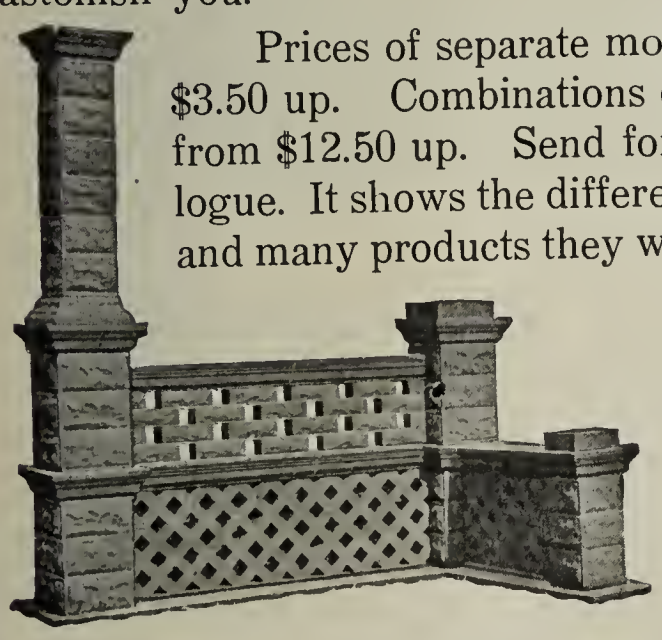

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A Large Gravel Washing Plant

A plant for preparing gravel for concrete and other commercial purposes, and for railroad ballast, has recently been placed in operation by the Joliet Sand & Gravel Company, of Chicago, at a point known as Rockdale, about 4 miles from Joliet, Ill., on the main line of the Chicago, Rock Island & Pacific Railway. It is said to be the largest plant of its kind yet erected. The company is a large producer of washed gravel, and has plants also at Plainfield, Elgin and Millsdale, Ill., the combined capacity of all plants now being 8,000 cubic yards per day.

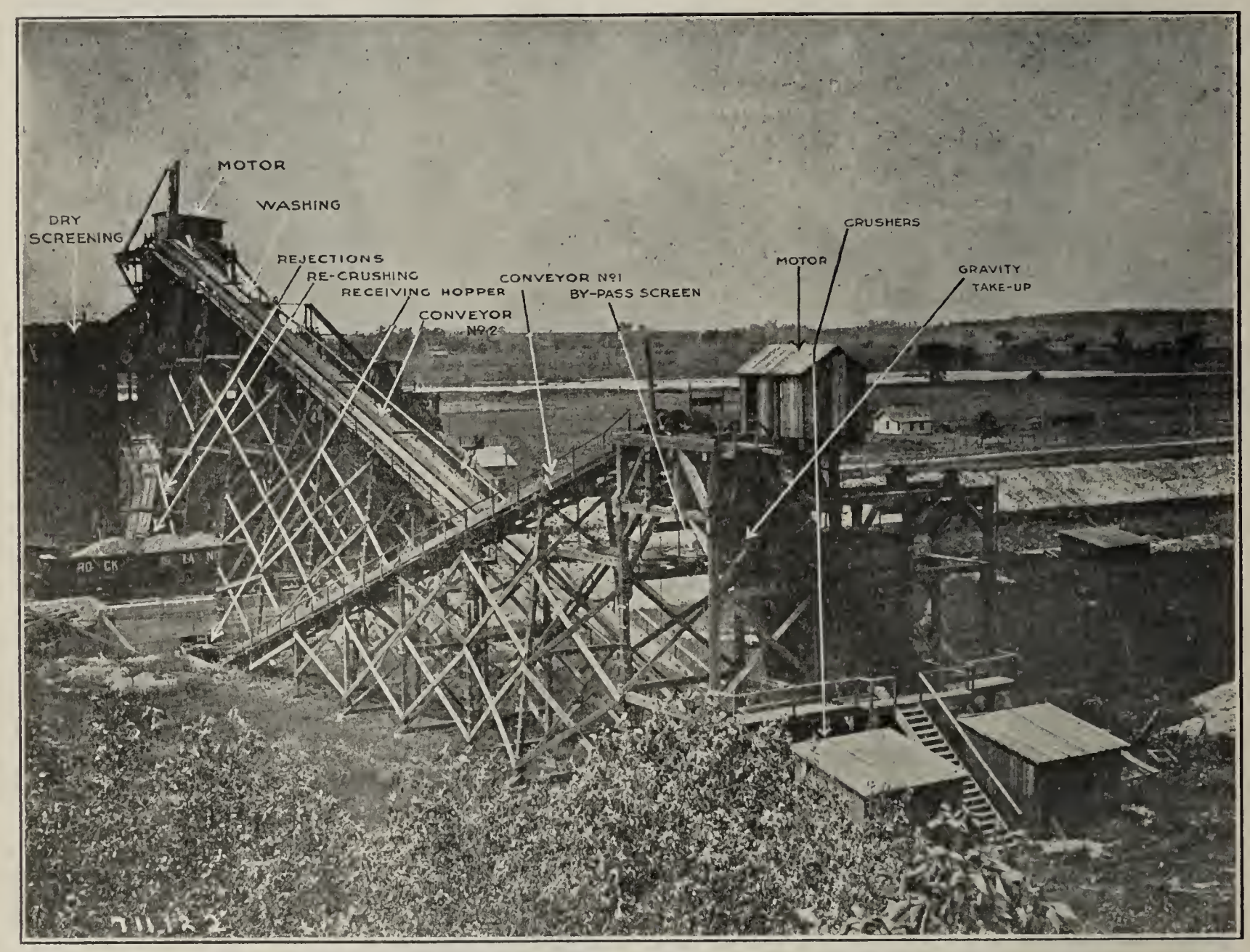
The plant is located beside a gravel deposit which extends a distance of 1¾ miles and attains a width of about three-quarter mile, tapering off to a point at each end. The bank covers 460 acres and has a height of 60 to 80 feet with a comparatively level top. The gravel is excavated by steam shovels loading into standard-gauge hopper cars, the present equipment comprising a 70-ton and a 65-ton shovel. Five or six loaded cars are made up into a train and hauled to the plant, where they are dumped into a large receiving hopper under an elevated track.

The shovels have a combined capacity of 5,000 yards per day.

From the receiving hopper the bank gravel is carried up an 18-degree incline to a dry-crushing plant on a 36-inch belt conveyor, about 195 feet in length between centers. This conveyor discharges over a 4-inch screen, which allows the fine material to pass directly to a second conveyor, leading from the lower part of the dry-crushing plant up to the top of the group of storage bins, where the screening and washing equipment is located. The over-size gravel from the screen is passed through a pair of No. 6 Allis-Chalmers gyratory crushers, which are driven by individual 50-h.p. Allis-Chalmers motors. Provision is made for two additional crushers in enlarging the plant. The output of the crushers is also carried by the second conveyor up to the screen and the washing plant. This conveyor is 36 inches wide, 250 feet centers, and is on an incline of 18 degrees.

Both conveyors are driven by individual motors at their head ends. Directly back of the heads they are provided with gravity take-ups, each consisting of a weighted pulley in a vertical frame allowing 9 feet of free travel up and down. This provides automatic take-up for 18 feet of belt at the point back of the drive pulley, where the slack accumulates.

The screeening plant is divided into two parts, one for dry screening for railroad ballast and one for washing and screening gravel for concrete purposes. The second conveyor ordinarily discharges into the hopper feeding the washing screens, but when it is desired to screen dry, a pivoted chute is let down so as to divert a part or all to two cylindrical dry screens. These screens have 2-inch perforations. The fine material drops into a storage bin, while the over-size is rejected to a spout leading over the loading track and delivering to a pair of 36-inch disk crushers. These crushers are located directly beside the track hopper and their rejections pass into it and then again through the dry-crushing plant and back to the screens.



General View of the Joliet Sand and Gravel Company's Plant.

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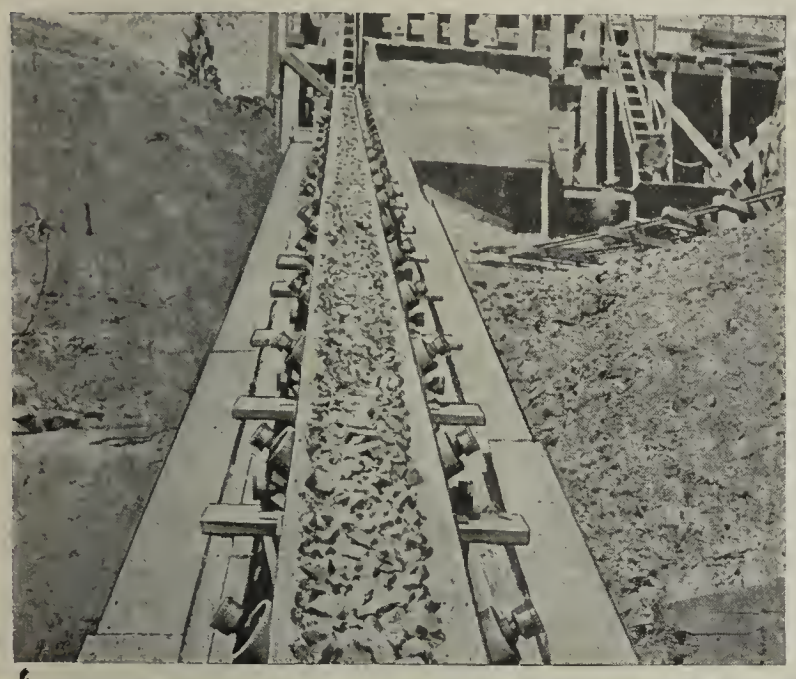
The Link-Belt Belt Conveyor

Shown in the illustration carries crushed rock from quarry and delivers to a Link-Belt Continuous Bucket Elevator, which in turn delivers to bin



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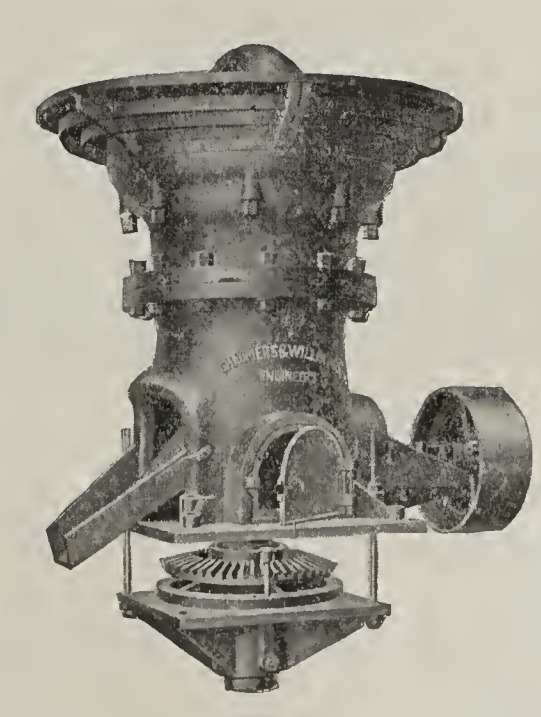

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Three sets of washing screens are provided for the first three separations, but the reduced volume of the gravel passing to the fourth separation requires only two screens. These final screens deliver into a pair of double-discharge settling tanks, in which the sand is separated from the mud and clay, which is passed off in solution. The washing screens are all improved type, 36x84 inches. Each screen of the first three sets is provided with an inner skirt with perforations one-quarter-inch larger than those of the outer plate, the skirt extending nearly the full length of the main screen plate, so as to increase the screen's capacity by relieving it of the larger sizes and also to make the separations accurate.

The sizes produced by the screens are those demanded by the market of Chicago and vicinity. The first set rejects to the chute returning to the crushers all material above that passing 2¼-inch perforations. The second set rejects to bin No. 2 all above 1¼ inches; the third set rejects to bin No. 3 all over one-half-inch and the fourth to bin No. 4, all over three-eighths-inch. Material below three-eighths-inch constitutes sand, which is passed from the settling tanks to bin No. 5.

The storage bins are cylindrical steel tanks, a type which has proved economical for permanent plants in the experience of this company. The screening and washing plant is supported on top of these tanks. Railroad tracks run along the two sides of the group of bins and each bin is provided with four quadrant type gates with counter-weighted chutes for loading into gondola cars. The tanks are not hoppered, but the gravel is allowed to form its own bottom at the level of the gates. The bins are all 19 feet in diameter and the effective capacity above the gates is 380 cubic yards each for bins 1 and 2; 315 cubic yards for No. 3; 251 cubic yards for No. 4, and 190 cubic yards for No. 5, or the sand tank.

The water supply is secured from a trench, excavated to a depth of 15 feet for a length of about 100 feet. Sufficient water accumulates to supply the plant, obviating the necessity of a pipe line to the river. A centrifugal pump, driven by a 50-h.p. motor, delivers water to the screens at the rate of 1,200 gallons per minute.

The plant secures power conveniently from the Public Service Corporation of Northern Illinois, delivered to the plant at 8,000 volts and stepped down there to 440 volts. Individual electric drives are used throughout the plant. A complete system of electric signal bells is also installed, assisting in the operation and control of the various units.

Steam Shovel, Digging Gravel at the Pit of the Joliet Sand and Gravel Co.

The plant was put into trial operation early in July, and though conditions incident to the opening of the gravel bank curtailed the supply so that it was possible to run only at limited capacity, the owners expect to obtain an output of 2,500 to 3,000 cubic yards of washed gravel per day.

SIDEWALK AND CURB FORMS.

The oldest concern in the market manufacturing steel forms for concrete sidewalk and curb and gutter work, The Hotchkiss Lock Metal Form Company, Department O, Binghamton, N. Y., are so thoroughly convinced that their forms are the best and most practical, that they are shipping them, free of cost, to those that care to try them. Write for their latest booklets and testimonials of those who are now using them.

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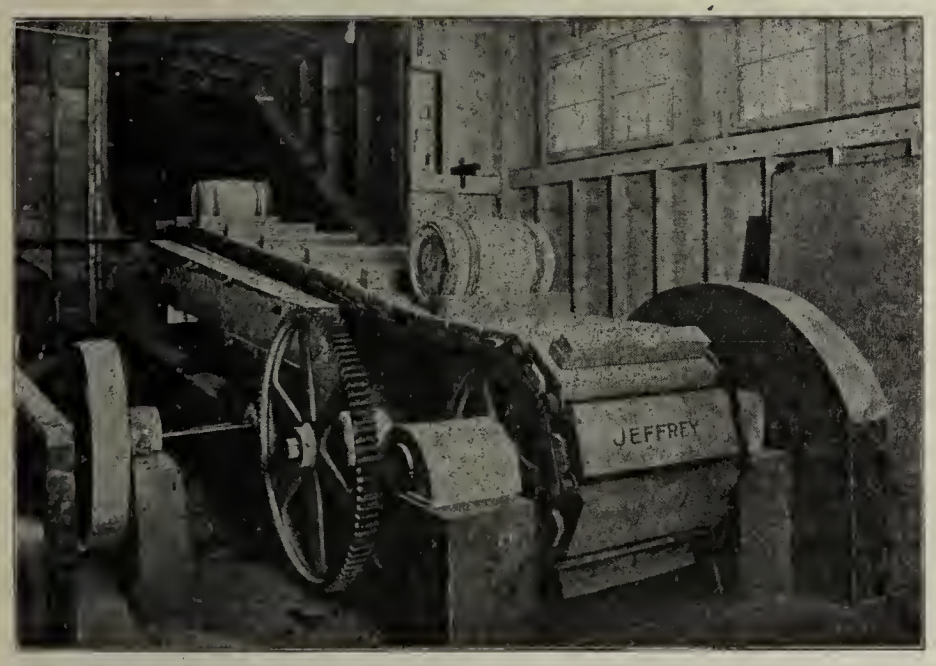

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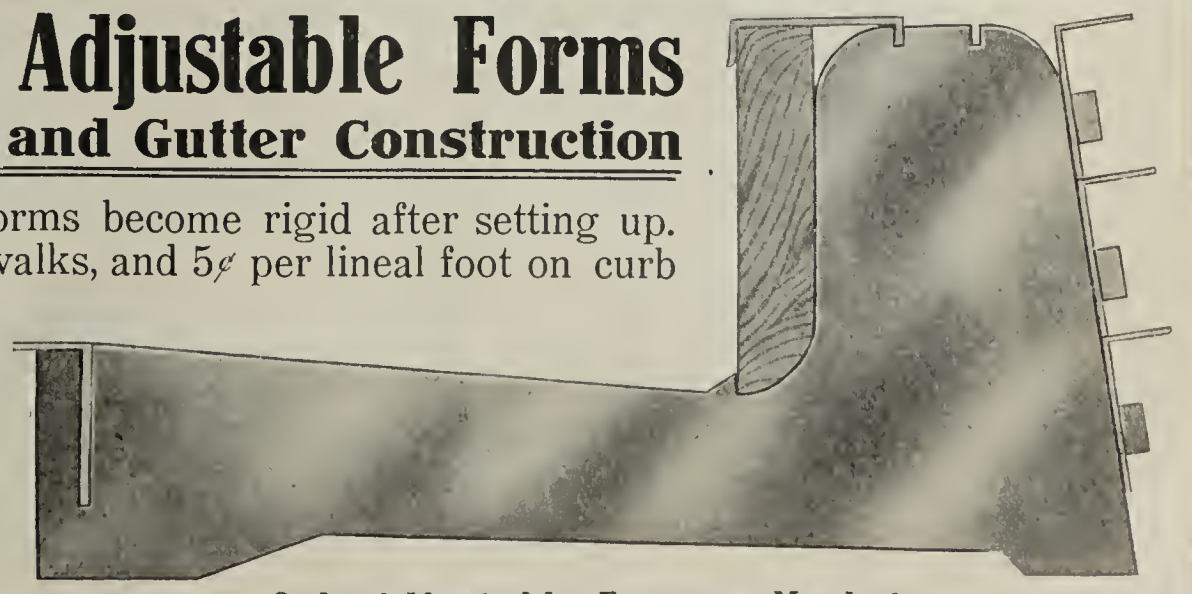

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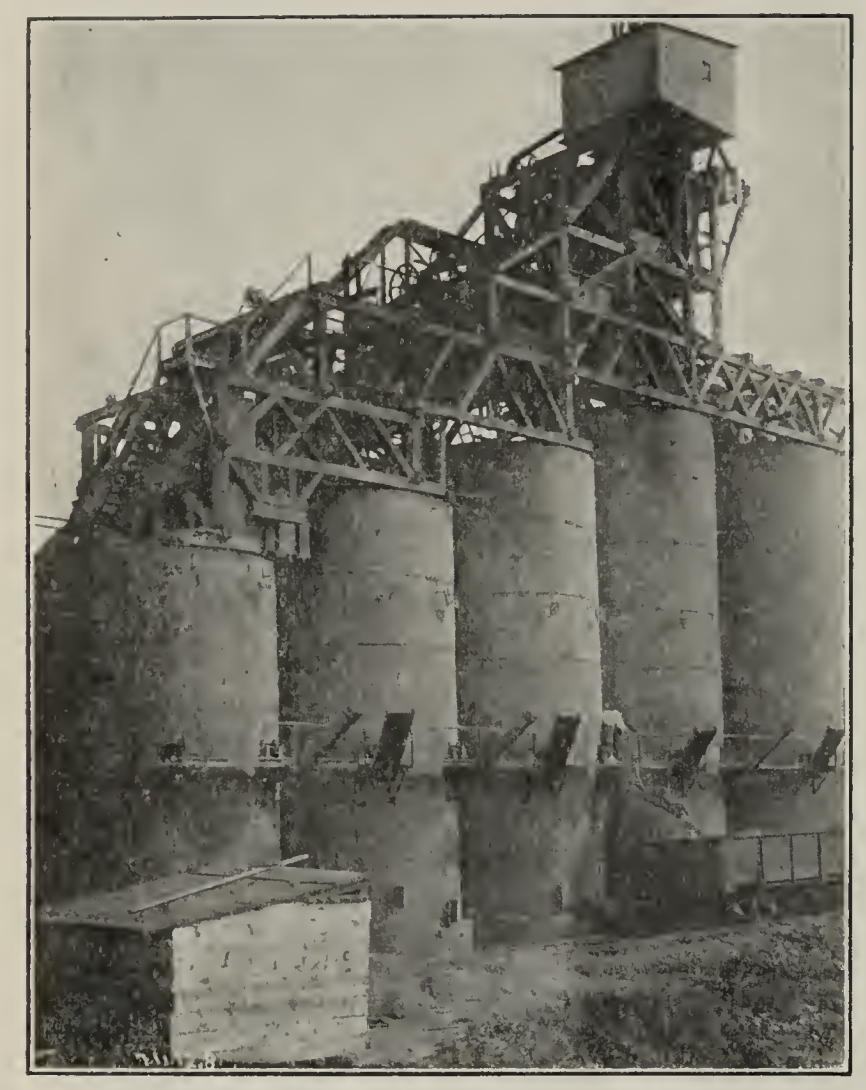
OMAHA CEMENT SHOW.

The board of directors of the Nebraska Cement Users' Association met at the Rome Hotel in Omaha, July 30, 1912. At this meeting arrangements were made and dates set for the annual convention and Mid-West Cement Show.

They have made arrangements for the Auditorium for the dates, February 6, 7, 8, 9, 10, 11, 12, 1913. The board of directors in setting the dates have varied



Screening Plant and Bins, Showing the Discharging Chutes, Joliet Sand and Gravel Co.

somewhat from the usual custom of holding the show during the week, having decided to open this show on Friday morning and running it until Tuesday night. The idea in making this change was, that by holding the show on Saturday the large Saturday afternoon and night crowds would be there that have heretofore been missed. Then by resting on Sunday it would give the exhibitors a chance to rest up and look around and get a line on prospects that had developed the first two days so that they could be closed up on Monday and Tuesday.

Then there are always a lot of prospects that will run into Omaha on Saturday morning and take in the show and go back on Sunday.

The outlook for a big show has never been better. Crops all over the Mid-West are good. There has been a larger demand for cement throughout the country than ever before and a good many cement users will be looking for new machinery and supplies.

Also the fact that there will be no show nearer than Chicago this year, and that the show comes at a time that is neither too early or too late in the season, has made the board feel that the prospect for a good show could not be brighter.

The arrangement of the Auditorium will be practically the same as last year, and the prices will run about the same. The association will have a trunk line installed for electric power, same as before, so that the cost of power and connection will be very small.

Frank Whipperman, the secretary, says that plats and space contracts will be out soon There has been a good many inquiries for space at this show. Nearly half of the exhibitors who were here last year have selected the same spaces for this year's show.

The secretary residing in Omaha, will be on the ground all the time and with a good board of boosting directors and the publicity bureau of the Omaha Commercial Club, will make this the best cement show ever held outside of Chicago.

NATIONAL ASSOCIATION OF CEMENT USERS.

President Humphrey of the National Association of Cement Users, is busily engaged in preparing the program of papers and addresses for the convention to be held in Pittsburgh, December 12-18. Efforts are being made to secure papers from not only the most famous authorities of this country but from the experts of foreign countries as well. The entire field of concrete construction will be touched upon by the subjects as outlined by President Humphrey. The proceedings of the association each year constitute the most valuable contribution to the knowledge of concrete that may be found anywhere. The various standing committees have received letters from President Humphrey containing instructions to push their researches as rapidly as possible so as to be able to report their findings and conclusions when called upon at the convention in December. An active pre-convention campaign for more members is being conducted by Secretary Edward E. Krauss. The annual dues are only five dollars and the Secretary seems to have no difficulty in convincing those who do not belong that membership in the association is worth several times the annual dues. The association should have the support and encouragement of everyone identified with the use of concrete in any capacity.

View of Crusher, from the Main Plant.

CEMENT
... AND ...
ENGINEERING NEWS

A WATER TEMPLE

(Courtesy of the "Architectural Record," New York.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY

WILLIAM SEAFERT, Editor and Publisher

OFFICE—1117 Schiller Building

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CHICAGO, NOVEMBER, 1912

A DIRECT APPEAL TO THE FARMERS OF ILLINOIS FOR PERMANENT HIGHWAYS.

The Illinois State Highway Commission has been energetic in furthering good roads among the counties of Illinois. The services of State Engineers have been gratuitously furnished for the design and construction of bridges and highways, and while every type of road has been experimented with, yet the feeling of the State Highway Commissioner, Mr. A. N. Johnson, has been that a permanent solution must be found rather than the temporary expedients which have been offered in macadam and the various special macadam roads.

On the State Fair grounds at Springfield is an experimental section of road consisting of several types of pavement, each of which is built to sufficient length to show the relative merits. There is one section of "Dolarway" which was built prior to the Fair of 1911 and which shows absolutely no wear. Sections of plain macadam and bituminous macadam are on either side.

This year Mr. Johnson has extended his demonstration work, out the Peoria road toward the laboratory of the State Live Stock Board. Believing that the concrete highway is the most economical solution and following the experience of Wayne County, and of other counties which have found concrete to be most satisfactory and economical, he has built three-quarters of a mile of concrete road six inches thick at the sides, eight inches thick at the center and eighteen feet wide. It was to be a demonstration road to show the farmers of not only Sangamon County but all who should visit the State Fair the practical value of concrete for the country highway.

The road was started about two weeks prior to the opening of the Fair, on October fifth, and during the Fair was completed.

For its construction the Universal Portland Cement Co. donated one thousand barrls of Universal Portland Cement, which was almost sufficient for the entire road. The balance of the cement was bought on contract.

The road starts at the entrance to the State Fair grounds and runs north along Machinery Hall, following the eastern boundary of the grounds. Its location was intentional, as by placing it here the maximum number of farmers might inspect it at the time of the Fair.

Within the grounds, and but a few feet from the demonstration road, the Universal Portland Cement Co. showed, by means of moving pictures, the construction methods in use in Wayne County (Detroit), Michigan, in the building of concrete highways. The film also showed the early conditions in Wayne County, typical scenes along macadam roads (both new and after a few years of travel) and the later results showing automobiles traveling at high rates of speed along the concrete highways without a particle of dust, and teams heavily loaded, trotting along at speed impossible on the average country highways. It was a popular presentation of a technical matter. The farmers were interested and many left with the intention of further investigation of concrete highways.

It was particularly fortunate that a road could be under construction and partially completed at the time when the moving picture exhibition was given. Those who showed an interest were invited to inspect the road outside the Fair grounds and parties of inspection were made up at intervals. That the farmers are fully alive to the need of better road facilities was proved by their intense interest in the moving picture exhibit and also in the actual road.

The demonstration road was made under the specifications of the State Highway Commission, which differ only in minor points from those commonly used in Wayne County, Michigan, and other counties where a large development has already been made. It is without doubt the forerunner of much concrete highway construction in the State of Illinois.

CEMENT & ENGINEERING NEWS' SWORN STATEMENT MADE UNDER NEW POSTAL LAW.

Statement of the ownership, management, etc., of Cement & Engineering News, published monthly at Chicago, required by the Act of August 24, 1912.

Note—This statement is to be made in duplicate, both copies to be delivered by the publisher to the postmaster, who will send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the postoffice.

Publisher and Editor, William Seafert, 435 South Marshfield av., Chicago.

Business Manager, J. F. Waldron, 4201 Princeton av., Chicago.

Owners: (If a corporation, give names and addresses of stockholders holding 1 per cent or more of total amount of stock.)

Cement & Engineering News is not incorporated. It is owned by William Seafert.

In regard to Section 2 of the law, Cement & Engineering News does not accept payment for any editorial or other reading matter printed as news.

Known bondholders, mortgagees, and other security holders, holding 1 per cent or more of total amount of bonds, mortgages, or other securities:

There are no bonds, mortgages or other securities outstanding against Cement & Engineering News.

Sworn and subscribed before me this 30th day of September, 1912.

(SEAL) ANNA M. NIZZE, Notary Public.

(My commission expires March 8, 1914.)

Intluence of Moisture on the Expansion and Contraction of Concrete

The formation of cracks has an important bearing on the life of concrete pavements, and in order to reach an understanding of all of the factors involved in cracking, or, in other words, in the expansion and contraction of concrete, the office of Public Roads undertook a series of tests which early this year had progressed far enough to indicate the influence of moisture on expansion and contraction. A paper on these tests was read by Mr. Logan Waller Page, director of the Office of Public Roads, before the Ohio State Engineering Society, and has been reprinted in the Society's proceedings, from which the following abstract has been prepared.

Numerous cracks appear in many concrete structures soon after their completion and the reason in most cases is not the failure of the concrete to resist the external loads imposed, but is due to the inherent contractive qualities of the concrete mass. The shrinkage due to a fall in temperature has been very carefully measured by a number of investigators, who quite generally agree that 0.0000055 in. per inch of length per degree Fahrenheit is the correct value of the contraction. The temperature changes are due not only to the variation of external temperature, but also to the chemical activity of the cement during the hardening process.

The fall in temperature of a mass of concrete caused by atmospheric change has long been recognized as being of sufficient magnitude to cause cracking. It has also been demonstrated, notably by the Boonton Dam Experiments, that very high temperature may be developed in large masses of concrete during the hardening process. In time, as the heat is dissipated by conduction and radiation, the temperature is bound to fall, with the production of enough tensile stress to cause cracking. Another source of contraction, that due to drying out the water from the concrete mass, is likewise known to exist, but the information is qualitative rather than quantitative.

Method of Making the Tests.

The tests were conducted on columns 8 in. square and 5 ft. long, and the concrete was mixed in the proportions of 1:2:4 and 1:3:6. The materials used were Portland cement passing the specifications of the American Society for Testing Materials, well graded, clean river-sand, and crushed gneiss. Two consistencies were used—very wet and very dry. The very wet concrete was simply puddled into place, while that of very dry consistency was tamped into the mold with difficulty.

One-half-inch bars, square in cross-section, were molded in the specimens 50 in. apart. Upon removing the wooden forms these bars projected 1½ in. on each side of the specimens. Steel plugs with rounded conical points were attached to the square bars, and measurements were taken between the points by means of a micrometer fitted to a specially designed frame. With this apparatus, readings could be taken accurately to a few ten thousandths of an inch.

As soon as the concrete had hardened sufficiently, the molds were removed and the initial readings taken. The temperature of the specimens and that of the air were noted at each reading of the micrometer, and all readings were corrected to constant temperature. In this way the influence of temperature changes either in the atmosphere or in the concrete were eliminated and the deformations obtained therefor represent the change in length of the concrete due to the effect of moisture alone.

Results of Measurements.

The results obtained agreed with those of previous investigators in showing that concrete expands when it is allowed to harden under water and contracts when allowed to harden in air. Those specimens which hardened in air showed contraction almost from the beginning of the test. A very slight expansion, too small to be plotted, took place during the first day or two. The tests indicate that the 1:2:, mixture contracts more than the 1:3:6 mixture; likewise that the greater portion of the contraction takes place within the first three months and fully 50 per cent of it within the first month.

The amount of the maximum contraction at six months is 0.00068 in. per inch of length in 1:2:4 concrete, a figure which goes far toward accounting for the rupturing of many concrete constructions, even when temperature changes are negligible. If it is assumed that the ends of a concrete construction are rigidly held and the concrete is allowed to harden in air, the tendency toward shrinkage would immediately create a tensile stress in the concrete mass, and its amount at the end of six months would, if this were possible, be equal to 2,000,000 multiplied by 0.00068, or 1,360 lbs. per square inch, if the modulus of elasticity is assumed to equal 2,000,000 lbs. per square inch in tension. Concrete is capable of withstanding only from 100 to 200 lbs. per square inch in tension, so that even when there is absolutely no temperature change, it is impossible for a plain concrete construction to remain intact when enough resistance is offered to its free contraction due to drying. The decrease in length of a mass of concrete 100 ft. long due to the drying out of the moisture would be about 0.81, or roughly ¾ in. To cause the same amount of contraction, a fall in temperature of 124 deg. Fahr. would be necessary, but this is a range in temperature which few concrete constructions receive. It would seem, from the above figures, that the temperature changes in some concrete constructions play but a secondary role in the production of cracks.

A test was likewise conducted on a specimen of 1:2:4 concrete reinforced with ½-in. round rods placed 1 in. apart and extending the entire length of the test-piece. The contraction of the concrete in this case amounted to 0.0003 in. per inch of length, as compared with about 0.00068 in. in the corresponding unreinforced specimen. The steel in this specimen is undoubtedly receiving high compression from the results of the shrinkage of the concrete.

Concrete Hardening Under Water.

In obtaining the change in length of concrete under water, the specimens were first allowed to harden for two days in air, then measurements were taken with the micrometer. After measurement, they were immersed in water in a horizontal position and, in order to permit their free expansion, they were laid on rollers. The results of the measurements showed that in every mixture of concrete tested a decided expansion took place. At the end of three months the specimens were still expanded and exhibited at that period a change of approximately 0.0001 in. per inch of length —a value from one-fourth to one-sixth of the contraction of the same kind of concrete when stored in air. After about one month, the length of the specimen remains practically constant, as nearly as can be

judged from the results of the micrometer measurements.

When the ends of a concrete construction are fixed, the tendency toward expansion will be resisted with a resulting compressive stress at the end of three months of 2,000,000 multiplied by 0.000075, or 150 lbs. per square inch.

It thus becomes plainly evident that when concrete, which is continually wet, is prevented from free expansion, it may receive high initial compression from this cause. It is likewise evident that the steel in reinforced concrete beams may be subjected to high initial tension from the effects of this expansive tendency.

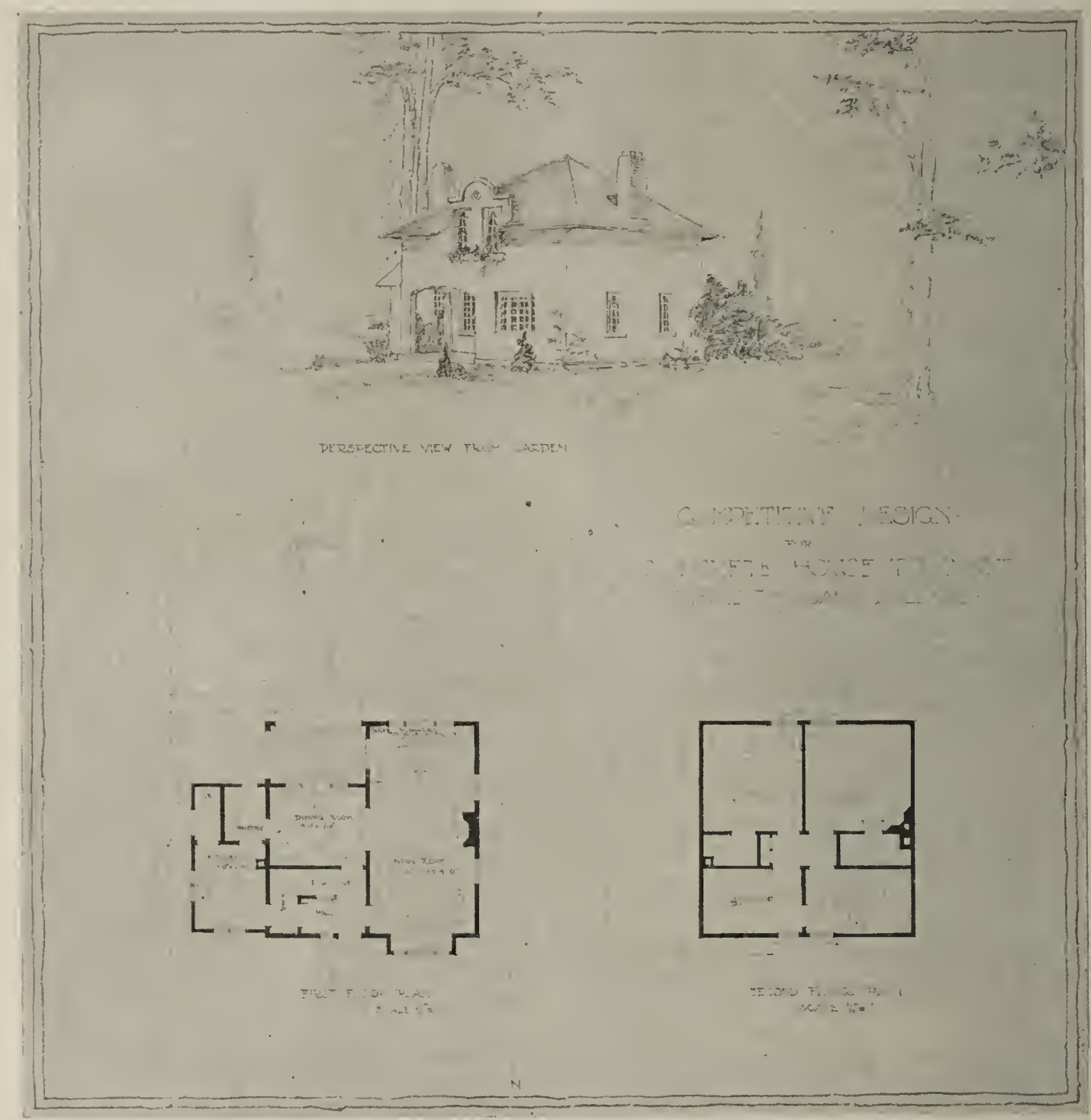
Measurements were also taken on specimens which were kept wet for about two weeks by means of a covering of wet burlap, and were then allowed to dry out. It was noted that, just as soon as the specimens were allowed to dry, they began to contract, and the ultimate amount of contraction was in excess of 0.045 per cent. When specimens which have contracted through drying are immersed in water, expansion again takes place.

The combination of water with the cement, with the resulting formation of colloids or gelatinous bodies having greater volume than that of the cement in its untreated condition, may account for some of the expansion. When the water is allowed to dry out from the concrete mass, the colloids shrink in volume owing to the loss of water, and the concrete mass therefore shrinks. It is not at all improbable that the expansion and contraction of the rock aggregate due to the change in moisture content is also of influence in causing a change in the length of the concrete mass of which it is a component.

Practical Phenomena of Expansion and Contraction.

These tests serve to explain the cause of many defects in concrete construction, and may suggest means for rectifying them. The fact that a concrete wall 100 ft. long might shrink ¾ in. in length due to drying, very clearly explains the presence of cracks in many such structures. In the case of a concrete roadway provided with expansion joints every 50 ft., each section is liable to shrink ⅜ in. due to the drying out of the moisture from the concrete, and this is again sufficient reason for cracking, considering the frictional resistance offered to free movement between the concrete and the foundation.

Many sidewalks divided into blocks and made with a top wearing coat of rich mortar laid on a concrete base, become dished in appearance in a short time. This phenomenon is readily explained by the fact that the rich mortar top coat contracts a great deal more than the concrete base, which may



Plans for small poured-concrete houses, submitted in a competition conducted by the Blaw Steel Construction Co., Pittsburgh, Pa., have been published by that company in a 24-page booklet. The designs are for a dwelling costing not over $3,000, ready for occupancy. The designs were judged by Prof. A. D. F. Hamlin, of Columbia University, New York. The drawings include floor plans and perspectives. Twenty-three of the designs submitted, including the prize winners, are reproduced. Individual specifications accompanying the plans are not included, but considerable space is devoted to a discussion of such points as require special attention in preparing specifications for concrete houses. The above design was submitted by F. W. Kervick, 706 Cottage Grove avenue, South Bend, Ind.

even be expanded owing to the retained moisture absorbed from a poorly drained foundation. The fact that the surface coat has a higher coefficient of expansion and contraction owing to wetting and drying than the concrete is sure to produce a shearing stress between the two coats which tends to separate them, with the resulting destruction of the surface. Disintegration of this character is often noticed in pavements in which the bond between the wearing coat and concrete is weak because the wearing surface has been laid after the concrete base has hardened.

It has been noted that structures of concrete made to contain water leak when allowed to dry out, but, when again filled, become watertight. The leakage in a great many instances may be ascribed to the formation of cracks due to shrinkage rather than to the porous condition of the concrete itself. When the concrete again becomes wet, it expands in length, the fine cracks are closed and the leakage is stopped.

If during a period of 6 months the temperature of a concrete mass falls 100 deg. F., each inch of length will contract 0.00055 in. If, at the same time, the mass dries out, each inch of length might shorten by 0.00068 in. The total contraction will be 0.00055 plus 0.00068, or 0.00123 in. A hundred foot length of concrete might possibly shorten, therefore, as much as 1,200 multiplied by 0.00123, or 1½ in. In large masses of concrete where the heat generated by the chemical activity of the cement in hardening has a chance to accumulate, there will be an additional contraction due to the subsequent loss of this heat.

Paper Against Cloth Sacks for Cement

When asked his opinion as to whether the best results were secured by buying cement in cloth sacks or in paper sacks, Leonard C. Wason, president of the Aberthaw Construction Co., Boston, stated that the correct answer to such a question is at the present time a much mooted question among the users of Portland cement. He then went on to say that he thought the time would never come when either form of package is entirely eliminated, but that as time went on and the buyers of cement analyzed more carefully the methods of the question, the use of paper sacks would steadily increase. In bringing out the disadvantages of the cloth package as compared to the paper package Mr. Wason took a hypothetical case which clearly showed the situation. To quote Mr. Wason:

"Let us assume the price of bulk cement to be $1.40 per bbl..

"'A' buys 1,000 bbls. packed in cloth and is invoiced at $1.80 per bbl., or $1,800. Of his invoice $400 covers the cloth bags purchased at 10 cts. each from the cement manufacturer. It is part of the purchase contract that the cement company agrees to buy back this $400 worth of bags for $400 provided they are all returned to the cement company's mill in good condition. The purchaser who does not carefully analyze the question therefore concludes that this cement cost is only $1,400 plus the item of freight in returning the bags.

"'B' purchases 1,000 bbls. of cement in paper bags and is charged $1.50 per bbl. for same; $1.40 being for bulk cement and 10 cts. for paper packages. His invoice is therefore $1,500.

"At first glance and before analyzing the question it would appear that 'A' had acquired 1,000 bbls. cement for $100 less than 'B,' a difference of 10 cts. per bbl. 'B,' however, who possesses an analytical mind, reasons to himself that he is better off than 'A' for the following reasons:

"1. 'A' has an item of expense for prepaying freight on the bags he returns. 'B' has none.

"2. 'A' has the time and labor expense of collecting, counting, storing, keeping tally, packing, carting, etc., of the cloth bags, which item is one of large proportions. 'B' has none of this trouble or expense.

"3. The cloth bags purchased by 'A' require time to untie and time and care to empty thoroughly. 'B's' paper sacks require little time to untie, can be handled easily, cut with a hoe, broken across a box or barrel and emptied instantly.

"4. 'A' sustained a loss of cement in transit, estimated at one lb. per sack or 4 lbs. in a barrel, sifting through the bag in handling. 'B' sustains no loss through sifting. He runs the risk of a possible loss in tearing, but the present good grade of Manila rope paper sacks turned out by the established bag manufacturers reduces this risk to a minimum. The quality of paper turned out today is better than any heretofore produced.

"5. 'A' sustains a loss in emptying his cloth bags. Laborers are often so careless as to leave from .5 to 1.5 per cent adhering to the sides of the bags. 'B's' paper sacks empty easily; no sticking of cement to sides.

"6. 'A' is almost sure to suffer loss through theft and carelessness. A cotton sack is an attractive article to laborers. They use them for aprons, tool bags, clothes for the family, and they are handy to have around the house for other purposes. They are also used to carry coal, brick and stone, and every bag so used is damaged or destroyed. 'B' suffers no loss through this channel.

"7. 'A' runs the risk of loss through dampness. Moisture is absorbed and easily penetrates the cloth bag, damaging the cement and causing it to stick to the bag. 'B' suffers no loss from ordinary dampness, and, in fact, cement in paper bags frequently goes through short rain storms without damaging the cement.

"8. 'A' suffers a loss of 40 cts. or 2/7 the price of a barrel of bulk cement for every four bags unreturned to the mill. If the bags are not carefully packed several are often lost in transportation; if not properly tagged, whole bundles are often lost. Add to this the number of bags not returned because stolen or not accepted because damaged and this item is surprisingly large. Fifteen to 20 per cent of bags purchased are lost or so damaged as to be worthless for credit. 'B' suffers no loss of this character.

"9. 'A' runs the risk of, at least, a disagreeable dispute with the mill over the sacks he has returned both as to the condition of the bags and the count. Disputes take time and energy and are costly to both parties. Furthermore, the cement mills usually take their estimate of condition and count as final. 'B' through the use of paper sacks, obviates this possible disagreeable feature in his business.

"10. 'A' runs the possible risk of not getting the brand of cement specified. Unscrupulous dealers have been known to pack poor cement in second-hand bags bearing the label of the brand supposedly pur-

chased. 'B' knows positively he is getting the brand he orders.

"A" pays the cement company a profit ranging from 10 per cent to 40 per cent on every cloth bag he is obliged to purchase from them at 10 cents each, since the cement companies purchase the cloth cement sacks at from 7 to 9 cents each, and their customers buy these bags after they have often had as many as five or six deliveries with them, at 10 cents each.

"The buyer of cement, who like 'B,' carefuly analyzes this problem will, in my opinion, come to the conclusion that a paper package, when made of stout, tough paper, gives a service which is well worth the apparent higher cost.

"'B' estimates that the apparent differential of $100 in favor of cloth on the 1,000 bbl. order here referred to, is reduced 60 per cent through the item of lost and damaged bags alone. On good authority 15 per cent is a just estimate of the number of bags which are not returned or which are so damaged as to receive no credit. Applying this estimate to 'A's' order, he will fail to receive credit for 15 per cent of 4,000 bags, or 600 bags, which he is obliged to buy from the cement company at 10 cents each, or for $60. This reduces the differential on the 1,000 bbl. order to $40. Now, in addition to the tangible cash loss from uncredited cloth bags, 'A' also sustains a tangible loss of about 2 per cent from cement sifting through the cloth in transit and from sticking to the inside of the bags when emptied. This item would, therefore, amount to $28, reducing the cash differential in favor of cloth bags to $12.

"'B' therefore figures that if the return freight charges, the time and labor of collecting, counting, storing, keeping tally, packing, cartage, etc., of the cloth bags, the lost time in emptying them, the risk of loss through dampness, the risk of a dispute with the cement company supplying the cement and the risk of not getting the brand of cement specified, is worth to him $12 or more, he is a gainer through having purchased his cement in paper bags."

Undoubtedly the above opinion will appeal to accurate thinkers as being well founded on facts and they will prove interesting to those who have hitherto given it the careful analytical study which it merits.

NEW TYPE OF CONCRETE FLOOR CONSTRUCTION.

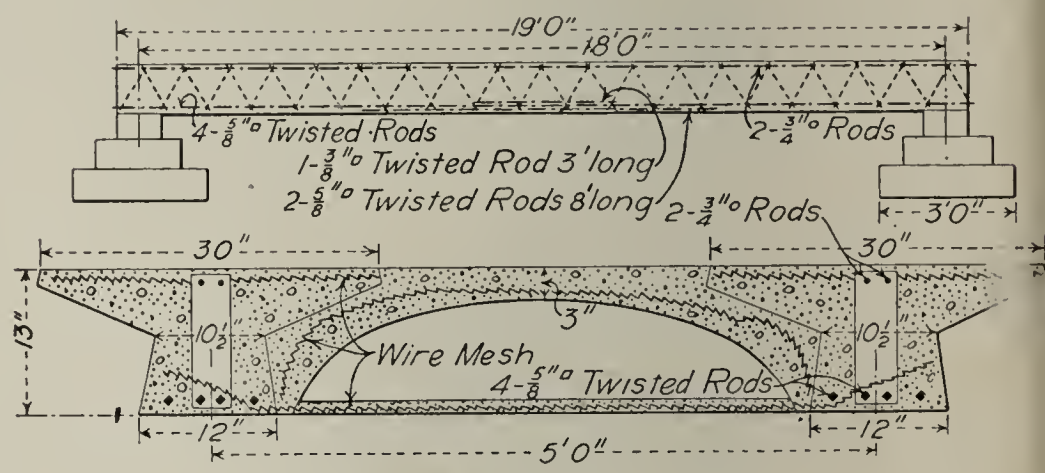
A reinforced concrete apartment house recently built in Los Angeles, Cal., has a floor system composed of a combination of T-beam and arch construction of a rather unusual nature. The new building is a 5-story apartment house, 60x120 ft. in area and is divided into bays with spans of 18 ft. between column centers.

The floor system, the main features of which are shown in the accompanying drawing, is made up of a series of T-beams with jack arch sections between these beams supporting the wearing surface of the floor. The longitudinal T-beams are 12 in. deep, 12 in. wide at the base and 30 in. wide at the top. These beams are spaced 5 ft. on centers and between them at the columns the intermediate beams are 3 to 6 in. wide at the base and 30 in. a the top.

The main beams are reinforced with four ⅝-in. square twisted rods in the lower section extending their entire length, supplemented by two ⅞-in. square rods 8 ft. long in the middle of the beam, and two small rods about two ft. long directly in the center section. The upper or T-section of the beam is reinforced with two ¾-in. round rods supplemented by American Steel & Wire Company No. 7 triangular mesh reinforcement. The diagonal reinforcement for shear is heavier at the ends of the beam than in the middle section and is rigidly connected with the ⅝-in. rods of the lower and the ¾-in. rods of the upper section.

Each of the arched sections has a clear span of 4 ft. and a crown thickness of 3 in. They are likewise reinforced with American Steel & Wire Company's No. 7 wire. The sections consist of beams which are first cast as units and then placed in position in the floor system, their ends forming the sides of the forms for the T-sections. Before placing them, however, the 1-in. flat ceiling slab is placed in position, with its wire mesh reinforcement carried beyond the slab section, in position to be bonded with the concrete section of the T-beams. With these members in place the required falsework and forms for the beam sections are reduced to supports for the arch beams, and the base of the T-sections.

The ceiling slabs are also made up in units and reinforced with No. 7 American Steel & Wire Company's reinforcement, and when in place they form a level ceiling without protruding beams. The use of this



Details of Concrete Floor Construction

method of construction is said to lessen the amount of steel and concrete required for any given loading and also to reduce the cost of form work.

The ceiling is given one coat of plastering for a final finish and from ½ to ¾ in. of concrete is sufficient to bring the floor up to the required level. The cost of the floor system complete averages about 33 cents per square foot. According to the engineers on the work, considerable inconvenience was encountered in building the arch blocks that make up the floor, on account of the limited space available. For this reason it is believed that the cost would be somewhat reduced if more adequate provision was made for that purpose.

In order thoroughly to test this method of construction before putting it into practice, a test slab was built by the Young Construction Company of Los Angeles, who were the contractors on the work, and loaded to destruction. This panel was 7 ft. wide and 19 ft. long, constructed in precisely the same fashion as the building, and was loaded with cement to a final failure, which resulted under a load of about 1,600 lbs. per square foot. Under this loading failure was due primarily to the settling of the footings of two of the columns, which allowed the beams to deflect.

The requirements of the building department of Los Angeles for apartment houses specify a floor construction capable of carrying a load of 60 lbs. per square foot with a factor of safety of four. The behavior of the floor slab under test thus vindicated its suitability for such service. Among the advantages claimed for this system, especially in carrying heavy loads, is the action of the arch beams that compose the floor panels in distributing the load to the carrying beams and thus to the T-sections.

Reinforced Concrete Cotton Mills

The Power Equipment; Electric Drive.

One of the first cotton mills of large size in the United States **to be built entirely of reinforced concrete** is the Maverick Mills, East Boston, Mass. The initial installation is about one-quarter of the ultimate layout. The first section, which has been completed, is a 51,200-spindle mill with a space in the existing buildings for 12,800 additional spindles. Ultimately the mill will operate 250,000 spindles.

Reinforced Concrete Buildings.

That portion which has been completed at the present time consists of a main mill 550x130 feet in dimensions, two stories in height; a 340x231-foot weave shed one story in height; a 30x40-foot two-story detached office building, and a 91x62-foot power house adjoining the weave shed. By the use of reinforced concrete for the spinning mill it has been possible to build a five-bay instead of a four-bay mill and still keep the story height to 16 feet. The outside columns are only 14 inches wide by 12 inches thick, and this gives a larger window space than is ordinarily obtained with brick construction. In order to obtain full benefit of the light, the floor beams are not used in the spinning mill, the floor slabs being carried entirely on transverse girders, which are parallel to the direction from which the light comes. To assist the lighting still further an arched floor slab is used, thickness 4½ inches at the crown and increasing to 6 inches at the supporting girders. By this arrangement the window heads can be carried higher than if a flat slab had been used.

The buildings are located on the harbor front and are supported by wooden piles capped with heavy concrete caps, the bottoms of which are carried 6 inches below the tops. The footings are reinforced by eight ¾-inch round rods, laid diagonally. Immediately above the piles and near the top of the footing, and immediately under the columns, are three 1-inch flat bars, 21 inches long, laid in each direction. The columns of the mill are set in rows 25 feet apart longitudinally and 10 feet 8 inches apart on centers. The columns of the weave shed are set in rows 21 feet 4 inches apart and 26 feet on centers, and every other column being carried through to support the roof girders.

The exterior walls are supported on continuous reinforced concrete girders carried on a line of piles spaced 24 inches apart on centers. The exterior walls are of reinforced concrete framework paneled with hollow tile left unplastered, the monotony of the end wall of the weave shed being broken by artificial concrete pilasters being erected at uniform intervals.

In the mill the story heights are 16 feet from floor to floor, with 15½ feet clear headroom from the under side of the girders. A temporary roof has been built over the mill, and the two stories built at present are designed heavy enough for two or more stories when the mill is extended. In the weave shed the clear headroom is 12 feet with under side of cross girders, which are 26½ inches deep to the under side of the roof slab. The columns are reinforced with vertical rods bound with hoops. The weave shed is covered with a saw-tooth roof, having sufficient stiffness in the saw-tooth girders to obviate the horizontal tie rods from bay to bay. Total rise of the saw-tooth is about 10 feet from the top of the columns to the peak of the roof. The floor construction is of the simple beam and slab type, designed to carry 150 pounds per square foot.

Interior view of Weave Shed Maverick Cotton Mills showing saw-tooth roof construction done in reinforced concrete; cement finished floors with sanitary base are used throughout, graded at proper intervals to outlets, making an absolutely vermin-proof as well as fire-proof building. Provision is made here for twelve hundred looms.

The Power Equipment.

Power house, 91x62 feet, is of reinforced concrete, divided into two parts by longitudinal wall. One section is divided into a one-story boiler room, the other a basement and one-story turbine room. Foundation

is formed of wooden piles capped with reinforced concrete beams; the foundation of the engine room consists of 22 inches reinforced concrete mattress, foundations for turbine and generators being independent from floor construction. Provision has been made to extend the power house as demand requires.

Boiler room equipment consists of three 400 horsepower Edgemoor water tube boilers designed to operate 180 pounds, equipped with Foster superheaters capable of 100 degrees F. In the turbine room there is a 1,500 kilowatt, three-phase, 60-cycle, 600-volt Allis-Chalmers turbo alternator, complete with engine and motor driven exciters of 22½ kilowatts each, together with necessary switchboard. This equipment was furnished by the Allis-Chalmers Company of Milwaukee.

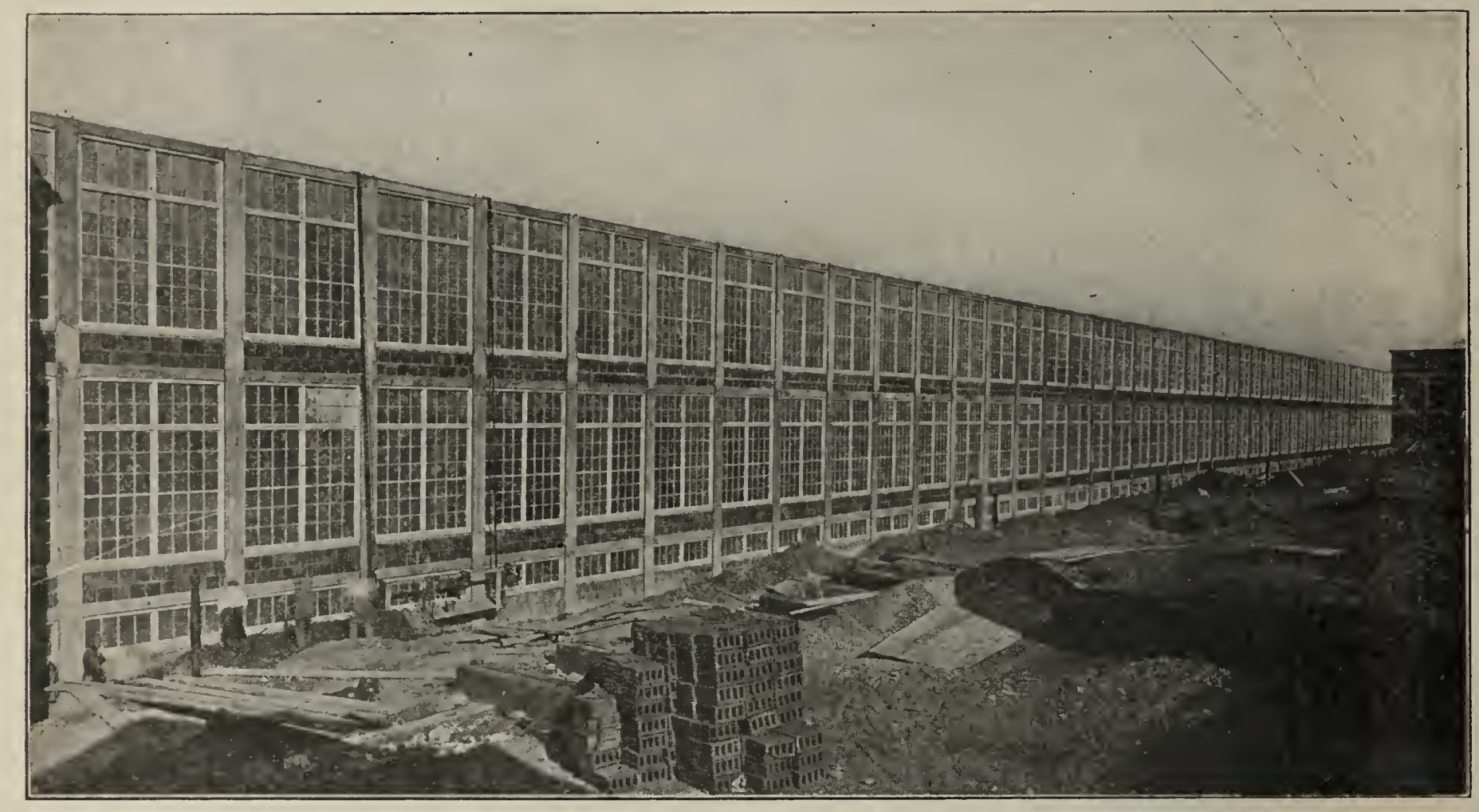
Initial installation of cotton machinery consists of 51,200 spindles, with place for 12,800 additional. The weave shed is equipped with 1,000 Stafford looms, with space for 240 more. The cloth room and repair shop are located one side of the weave room.

Electric Drive by Direct and Group Systems.

Electric drive is used throughout, the motors being standard three-phase, 60-cycle, 550-volt, induction type built by the Allis-Chalmers Co., of Milwaukee, Wis. These are mainly of the ceiling type. The weave shed is driven by four 100-horsepower motors located in the basement on heavy concrete foundations carried on the column footings. There are 20 lines of shafting extending into four sections of five shafts each. Each motor drives five shafts through a counter pulley.

In the spinning room the well-known four-frame drive is used, a 20-horsepower motor with double pulley on each end driving four frames of 320 spindles each. In place of using a flange on these pulleys, the crowning on each section is ¼ inch off center. This means that the belt can be kept apart without climbing the flange and being thrown off. Motors in the spinning room are supported in an interesting manner. Bolt holes were left in the concrete girders and wrought iron plates were tightly bolted to either side of the concrete girders. On these plates were riveted angles to which were attached channels extending from bay to bay, and to these channels the motors are secured. Shafting for the weave shed is carried in ordinary wall hangers bolted to concrete columns.

The mill is under the able management of Robert Burgess, formerly treasurer of the Burgess Mill at Pawtucket, R. I., whose ideas as regards construction and details have been carried out by Lockwood, Greene & Co., engineers, Boston. Several years ago Mr. Burgess examined some of the cotton mills in France designed and erected in the Hennebique system, and it is not surprising that the directors of the Maverick Mills Corporation finally decided to balance the great advantages of reinforced concrete skeleton construction against the slightly increased cost over standard mill buildings. The plant was designed and erected by the New York office of the Hennebique Construction Co. The Allis-Chalmers Co., Milwaukee, Wis., installed the power equipment.



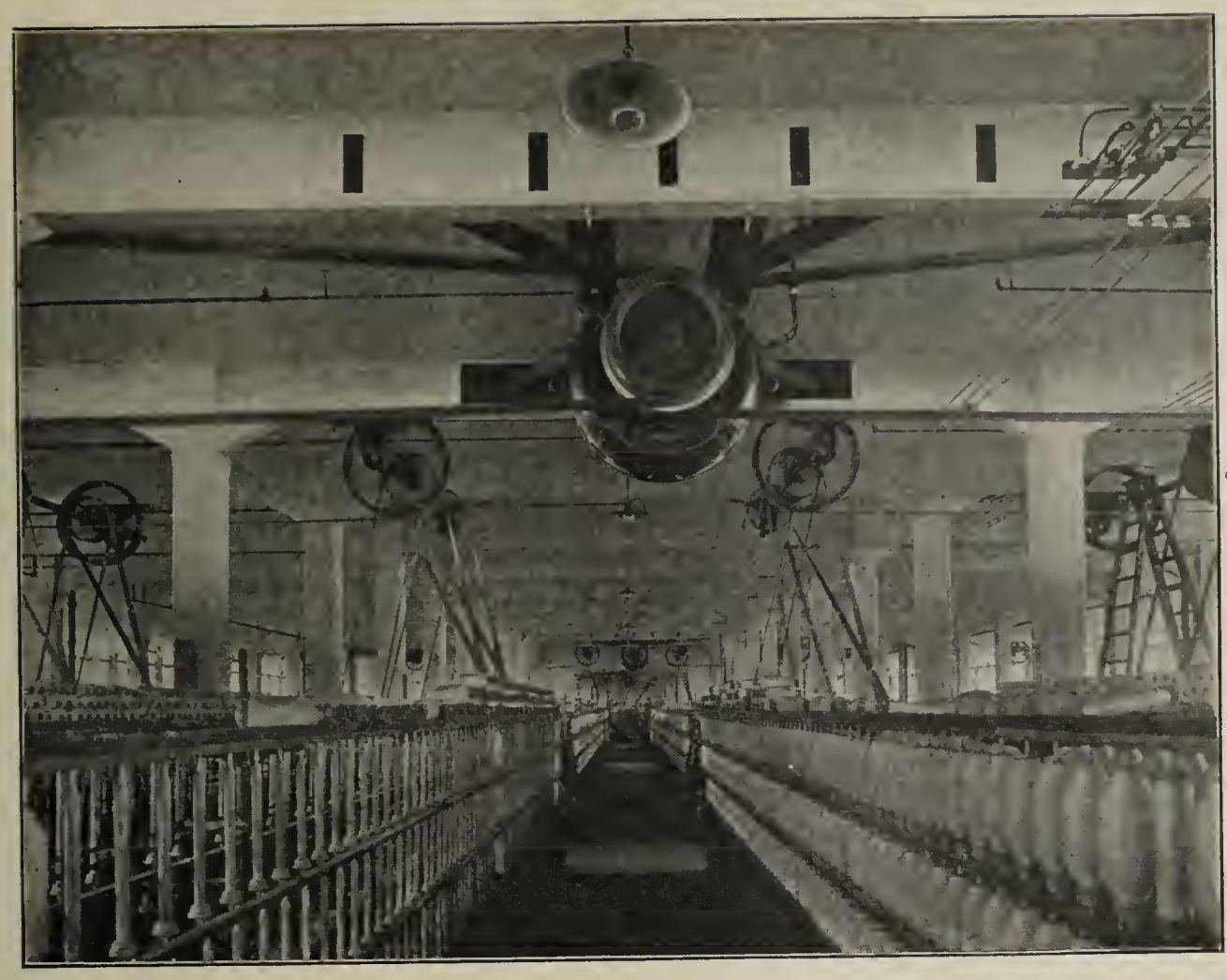
Exterior view of Reinforced Concrete Cotton Mill Building, two stories and basement, 130 ft. x 550 ft. Observe the enormous amount of window space made possible by the substitution of reinforced concrete columns for the brick piers commonly used. Buildings designed and erected by The Hennebique Construction Co., New York, N. Y.

CONCRETE FENCE POSTS.

The rapid deterioration in lumber at the surface of the ground, such as is found in fence posts, cribbing, curbing, etc., has led to the use of concrete and other forms of masonry for all work subjected to the ground moisture, as well as to the air close to the ground.

The rapid passing of the forests renders a new form of fence post imperative. The manufacture of cement has reached such a point that fence posts can now be built of concrete at about the same cost as wood. There is the added advantage that the concrete posts are made on the job when required, whereas the wood posts must be frequently shipped in from a distance and in quantities in excess of the temporary needs.

The Northwestern Steel & Iron Works, 1080 Spring



Interior view of Maverick Mills, showing warp frames. Observe the familiar 10 ft. x 25 ft. bays commonly used in wood construction which are not only possible in concrete design but prove very economical.

street, Eau Claire, Wis., have for some time been manufacturing molds for making concrete fence posts. The recent improvements on their molds permits a large number of posts to be made at one time, and still the plant occupies only very small space.

So successful have these posts proven that many of the railroads and other corporations requiring large numbers of posts are now manufacturing them for themselves. This means that the right of way will be

Interior view of Reinforced Concrete Power House, Maverick Mills, 91 ft. x 62 ft. The present installation consists of three 400 H. P. Water Tube Boilers equipped with Foster Superheaters, a 1500 K. W. Allis-Chalmers Turbo-Alternator and a Sturtevant Economizer, with induced draft outfit.

permanently protected and the public will be spared the sight of broken down posts, gaping holes in the fences, etc.

The Northwestern Steel & Iron Works has prepared very complete literature regarding these molds or machines and will be glad to send them to contractors and others interested in a product of this character.

MR. C. A. P. TURNER SUCCESSFUL AT VANCOUVER.

Announcement is made of the results of the competition inaugurated by the city of Vancouver in connection with the design and construction of the proposed Georgia-Harris street bridge. The successful design and estimate were submitted by Mr. C. A. P. Turner, of Minneapolis and Winnipeg, whose bid for a steel and concrete bridge was $431,600 and whose fee based on that amount will be $22,400. The prize of $750 attached to the second place in the competition went to Messrs. Waddell & Harrington, Kansas City, Mo., whose design and estimate involve an expenditure of $485,300. Messrs. Wilson, Lake & Bentall, of Vancouver, secured the third prize of $500, with an estimate of $533,330, and Mr. A. E. Stone, of Vancouver, the fourth prize of $250, with an estimate of $521,711.

The duties which are to be assumed by Mr. Turner for his five per cent engineering fee are defined as follows:

1.—Prepare all plans and submit a duplicate set for the city engineer.

2.—Provide all engineering assistance, including transit men, linemen, rodmen and chainmen.

3.—Provide a first class, fully qualified steel and concrete expert.

4.—Furnish a guarantee of design for the sum of $100,000 bond.

5.—Open office and supply all furnishings, staff, etc.

6.—Prepare all specifications in triplicate.

7.—Be fully responsible for all the work until the final completion of the undertaking, and its acceptance by the council.

8.—Allow free access to office and works in progress to the city engineer or authorized members of his staff.

9.—Undertake this work for a lump sum.

10.—Furnish all shop inspectors for steel work.

11.—In the event of the bids overrunning the engineer's estimate, the council shall have every right to cancel the contract without compensation to the engineer for his plans, etc.

Waterproof Concrete

By Albert Grittner.

(Translated from the German.)

Abstract from address before the International Society for Testing Materials, September, 1912.

The application of fluates for the preparation of waterproof concrete has long been known. The operation requires much time and labor; for the desired object can only be realized by applying the fluates several times. Endeavors have hence been made to find other materials which would render concrete waterproof, when mixed with it, and which would be obtainable at lower cost and be applicable with less trouble.

I have been investigating two such materials, namely, 'biber' and 'aquabar.' The experiments which I have been conducting have not led to any satisfactory results, although I applied the materials as prescribed by the manufacturers. These tests have further proved that biber may be replaced by common coal tar oils, and that equally good but unsatisfactory results are obtained without the latter. The substitution for aquabar, which is a soap solution, of a solution of an ordinary washing soap, has not been successful. But when common soap, which is a soda soap, was replaced by a potash soap, I realized not only favorable but indeed surprising results.

Before I pass to these experiments with potash soap, I should like to refer to the results which I obtained in my fluate experiments. For these experiments I used a Portland cement and a fine-grained artificial sand obtained from a Karst limestone. The sand consisted of 58 per cent of grains less than 3 mm. in size, and 42 per cent of grains more than 3 mm. in size. For testing the fluates, hollow cubes were prepared of 7 cm. edge and 1 cm. wall-thickness. In order to determine the height of capillary suction, prisms were also made, 21 cm. in height and 5 by 5 cm. in cross-section. Finally discs were prepared, 9 cm. in diameter and 1 or 3 cm. in thickness, and were subjected to water-pressure tests in a Böhme apparatus. Portland cement tested in accordance with the standard Hungarian specifications showed after 28 days a tensile strength of 37.4 kg. and crushing strength of 444 kg. The applied solution of magnesia fluate was 20°B. The specimens were made so that the density of the finished specimen was 2.31 The following were the results obtained:

The prisms and hollow cubes stood in 4 cm. of water; the latter were covered with glass plates to prevent any evaporation of the infiltrated water. The tests show that waterproofing can only be realized after applying several coatings of fluate, which would render the process too expensive. My potash-soap experiments were started at the instigation of C. Zielinszky, professor at the technical high school of Budapest, who had obtained good results when using potash soap on a concrete building. The Portland cement used in these experiments showed after 28 days a tensile strength of 31.8 kg. and crushing strength of 440 kg. The river sand used was fine grained, 94 per cent being less than 3 mm. in size. The density of the sand was 1.52. The gauge-liquid consisted of a soap solution containing 8 kg. of potash soap in 100 litres of water. It should be emphasized that the soap must be completely dissolved, which is best secured by taking care to use warm water and to filter subsequently through some loose fabric. The density of the specimens was 2.22. After being kept damp for 28 days, the specimen was placed on a hot stove and completely dried. When the tests were finished, the specimens were once more dried at 120°C. and again tested in order to ascertain whether the capacity for keeping the water out had not altered. The results were the same in the first and in the second instances. The dimensions of the specimens were the same as those used for the fluate tests. The table on next page shows the results.

mixture ratio	water, per cent of weight of cement	cement in kg per m³ of mortar	waterproof in which condition	consumption of fluate in kg per m³	suction rise in cm in the prisms after 24 hours	water, in grs. penetrating under pressure of 2·1 atm. per cm² through disc thickness of		water taken up by hollow cubes after 24 hours, in per cent of weight of the cubes	
						1 cm	3 cm	per cent	Note
1:3	50	458	without fluate	—	6	0·78	0·41	19·6	water height inside 3 cm
			fluate 2 times	0·4	5	0·31	0·24	9·2	water height inside 1 cm
			fluate 4 times	0·7	3	0·12	0·04	1·2	inner surface all moist
			fluate 6 times	0·9	1·5	0·04	0·00	0·7	moist in one spot

It was striking and indeed surprising to find in the case of these soft-soap test specimens, not only that the hollow cubes and the prisms were completely waterproof, but also that the disc, 1 cm. in thickness, could maintain a water column of 85 cm. without sinking after 8 days. Still more striking is the experiment in which the disc of 3 cm. thickness withstood a pressure of 2.1 atmospheres for 24 hours without showing any permeation of moisture.

This experiment demonstrates conclusively that a dense concrete which has been prepared with soft soap will be completely impervious to water without neces-

sitating the laborious operations required for a successful application of fluates.

It is not only this experiment which proves the accuracy of the facts that have been ascertained. Practical experience confirms this experiment. The tank of the water tower on Margaret isle in Budapest, 600 cubic metres in capacity, was prepared with potash soap, after experiments with hollow cubes had proved the concrete which was used to be completely impervi-

The Danube sand used for these experiments had a density of 1.62, and the volume of the pores amounted to 35 per cent. The coarse additions consisted of Danube pebbles of 2 cm. diameter at the highest, a density of 1.59 and a pore volume of 39 per cent. The concrete was made with 71.5 per cent of water and 8 per cent of soap solution (calculated for the cement applied) and was kept damp for three weeks before being submitted to the test. We also made from this

mixture ratio	liquid in per cent of cement	cement in kg per m³ of mortar	crushing strength after 28 days	suction rise in prism in cm		water column of 85 cm sinks in the disc, 1 cm in thickness, to cm		a water pressure of 2·1 atm. forces through disc of 3 cm in 24 hrs. per cm² grammes of water	water taken up by hollow cubes in percent of weight of the cube		Note
				1 hour	24 hrs.	24 hrs.	8 days		24 hrs.	8 days	
1:2·5	40	563	242	2	5	83	81	88	2·5	4·0	wet through, water has entered
			212	0	0	85	85	0	0	0	perfectly dry

ous to water. The preparation of such concrete with potash soap is not expensive. A cubic metre of concrete would at the most cost only 10 kronen (8s. 6d.) additional. It is true that a firm and quite dense concrete, free of voids, which has been carefully prepared and faced with cement, will also be waterproof; but this object can be attained by the aid of potash soap with much less trouble and care at much smaller expense.

One important question remained to be investigated.

concrete prisms of 21 cm. edge length and 5 by 5 cm. cross-section. These were likewise kept in the damp for three weeks and afterward dried in the stove at 100°C., and then placed in 10 cm. of water in order to determine the amount of water taken up by the specimen.

The results are tabulated below. I should add that I also prepared cubes of 20 cm. edge for the pressure test, and that the resulting strengths tabulated are means of three experiments.

mixture ratio by weight	liquid added	amount of liquid in per cent of cement	cement in kg per m³ of mortar	crushing strenght after 28 days	Sinking of the level of the 2 l of water in cube 150 mm water depth after				weight of prism after standing in 10 cm of water; grammes			water pressure of 2·1 atm. forces through disc of 3 cm thickness after 6 days per dm² grammes of water	Note
					1 day	2 days	1 week	2 weeks	originally	1 day	1 week		
1:1·5:2·5	water	71·5	300	83·2	10	15	42	65	1162	1223	1245	38·4	The discs werth dried after 3 weeks
	soap.		294	75·0	1	1·5	2	3	1176	1184	1194	0	

It must be admitted that a considerable saving might be effected, if the same object could be attained by using smaller quantities of cement. The question was: Is it really absolutely necessary that the cubic metre of concrete should contain 500 kg. of cement? Might not the desired end be secured with 300 kg. of cement? I therefore conducted some experiments in which a cubic metre of finished concrete contained only 300 kg. of cement. For these tests I prepared hollow cubes with 20 cm. of edge, the wall thickness being 4 cm. The specimens were made with Portland cement, which after 28 days yielded; tensile strength, 34.2 kg.; crushing strength, 337 kilograms.

These experiments demonstrate that a waterproof concrete can also be obtained by the aid of a potash soap if 1 c.c. of concrete does not contain more than 300 kg. of Portland cement. Just like the previous tests with 500 kg. of cement, these tests demonstrated that the discs 3 cm. in thickness, when exposed to a water pressure of 2.1 atmospheres for 6 hours, did not permit the smallest quantity of water to permeate; they did not even turn damp when potash soap had been used in their preparation. The same discs were completely wetted through in one hour when they had been prepared with water. When a waterproof concrete is to be made with potash soap, the chief condi-

tion to be observed is that the concrete should be perfectly dense; that is to say, free of voids. The pores between the sand particles should be entirely filled with cement; but since this would require a great deal of cement, it is important to know that the mortar may be mixed with pebbles and crushed stones, such that part of the volume of the pores is filled by this material, which is imbedded in the mortar. As a result of these experiments I have reached the following conclusions:

Conclusions.

1. A waterproof concrete can be prepared by the application of fluates. The operation, however, requires a great deal of time and labor.

2. By the application of an 8 per cent solution of potash soap, instead of water in mixing, the concrete can be rendered waterproof, so as to fulfill all requirements as to impermeability to water.

3. In order to prepare waterproof concrete with the aid of potash soap, we have to apply at least 300 kg. of a good Portland cement per cubic metre of concrete. When the cement is of a less superior quality, it will be advisable to take 500 kg. of cement per cubic metre of concrete.

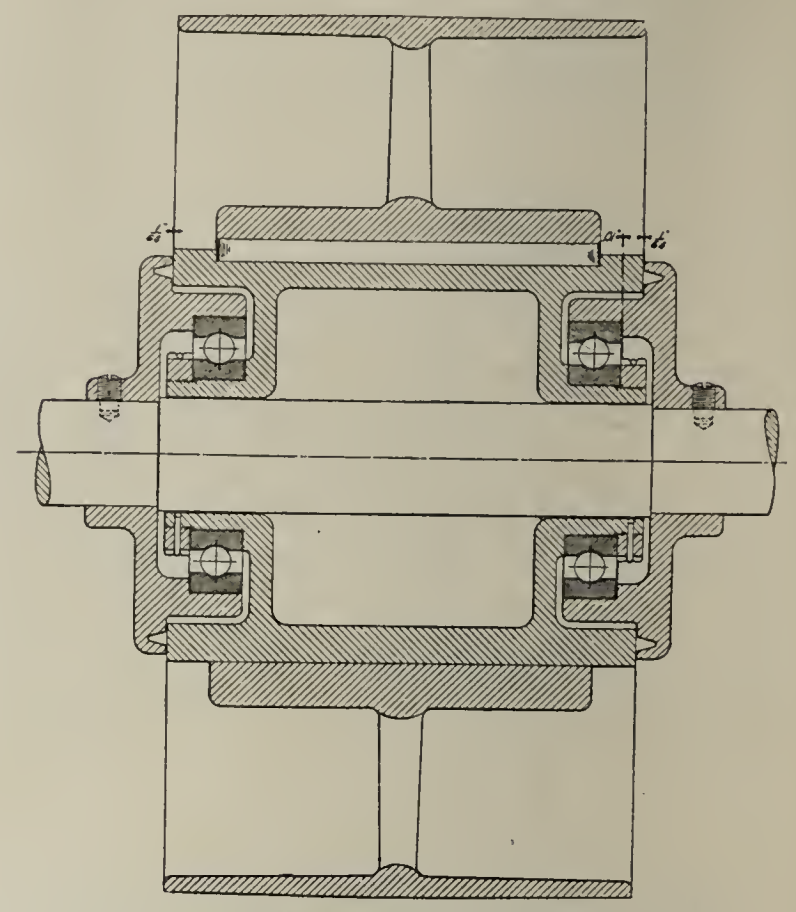
I conclude that a waterproof concrete which will satisfy all requirements can be obtained with the aid of a potash soap solution of 8 per cent when from 300 to 500 kg. of Portland cement is used per cubic metre of concrete.

BALL BEARING FOR VERTICAL LOOSE PULLEY.

The drawing shows a mounting recommended by the Hess-Bright Mfg. Co. for the application of Hess-Bright ball bearings to a vertical mule pulley. It is applicable, however, in other cases where a loose pulley is mounted on a vertical shaft. Two objects are attained by the peculiar form of mounting shown. One is retention of oil around the bearing; the other is distribution of wear around both races.

A little consideration will show that if the races were mounted directly on the shaft, as would be the more obvious construction, the comparatively high speed of the pulley would tend to throw out the oil by centrifugal force at the outer race. If, however, the shaft rotates slowly or is stationary, the movement of the outer race will be small or nil with the arrangement shown. Another feature of this arrangement is that the top and bottom mountings on the shaft are interchangeable, and the whole arrangement can be inverted end for end or inclined to a considerable angle without impairing its oil holding ability.

Following the standard rule in mounting Hess-Bright bearings, the inner races are a light press fit on the hub supporting them, and are clamped solidly by the nuts and locking rings shown. It is most essential that creeping of the inner races be prevented, as the surfaces on which they are mounted are not large enough to resist peening if creeping begins. The outer races are a close fit in the mountings attached to the shaft. The upper one has a slight endwise clearance; the lower one comes against the supporting shoulder. This arrangement allows both outer races to creep slowly around, thereby distributing the wear of the ball paths. This is found to be an important aid to durability sometimes. The grooved and lipped closures shown at top and bottom should have the minimum clearance possible, in order to prevent dirt from entering. It is found that the creep of oil is sufficient to provide, in conjunction with the dust naturally settling, an effective seal against the actual entry of dust.



Ball Bearing Mounting for Vertical Pulley.

The drawing shows a standard form of hub on which interchangeable pulleys can be mounted of like width but different diameters to suit different requirements.

STONE CRUSHING PLANT.

The new quarry of the Edward Balf Co., 26 State street, Hartford, Conn., and the crushers have been put in operation breaking the trap rock. The new quarry has a capacity of 1,200 tons of stone per day. There is a large storage capacity at the crusher, assuring the presence of a large supply to meet orders in every emergency, no matter how great the demand. The trolley lines switch under the dump and the cars are filled ready for delivery to any point between Hartford and Springfield. This includes these points: East Hartford, Windsor, Windsor Locks, Rainbow, East Windsor, Suffield, Warehouse Point, Thompsonville, Longmeadow, Mass.; Glastonbury, West Hartford, Farmington, Unionville, Bloomfield, and other places in central Connecticut, which immediately suggest themselves. Stone may be purchased in any quantities by the ton or by the yard. The large new crushing plant is advantageously located. It is equipped with the most modern machinery and money has not been spared to secure labor-saving devices. The large crusher and the two side crushers will turn out 1,200 tons of stone daily. Eighteen large Height roller bearing steel cars bear the stone from the face of the mountain to the pit. The car is dumped into the hopper and the stone is whirled through the three crushers and emerges in the chute below, which empties it into the awaiting cars on the trolley siding. There are three screens through which the stone passes. These sizes are produced: 1½, 1¾, ⅝, and ½-inch, as well as screenings and dust, the latter being used as a binder on highways. The plant is run by electric power.

SAND-LIME BRICK NEWS.

The newly incorporated Standard Brick & Tile Co. at Redlands, Cal., has completed plans for the construction of a factory at Colton, near the Santa Anna River, machinery for which has been contracted for with the American Clay Machinery Co., Willoughby, Ohio. The sand used will be secured from the Santa Anna River pumped from the river bed to the factory. It is expected that the plant will be in operation by July and has already booked good orders. The company is capitalized at $100,000, and its officers are Chas. A. Rolfe, president; Earle F. VanLouven, of Colton, secretary, and H. C. Newcomber, treasurer.

Concrete Smoke Stack at West Pullman, Ill. It was constructed by the General Concrete Construction Co., Chicago, Ill., for the International Harvester Co. 205 feet high above the ground, 18 feet in diameter at the base, 13½ feet in diameter on top. The forms used were sheet steel, 5 feet in length and were moved upward each day so that it required about 41 working days to complete the entire stack.

The Church Sand-Lime Brick Co., Sibley, Mich., writes: "You no doubt will be interested to know that we are having one of the best years in the history of our company. We are working overtime, and are still unable to supply the demand. We have no brick in stock and are two or three weeks behind on orders."

The Toronto Sand-Lime Brick Co., Toronto, Ont., report to date that they are making over 40,000 brick per day on two Komnick Rotary Presses, and at this writing have no brick in stock and have orders for over a million brick unfilled.

Buffalo Sandstone Brick Co., Buffalo, N. Y., report that they have orders which will take all of their stock and all they can produce for the next two months. They report sales of over half a million in Canada. The Canadian market is calling for all the brick they can get.

Rochester Composite Brick Co., of Rochester, N. Y., are making delivery on their order of several millions, to be used in the large N. Y. C. R. R. station now being constructed at Rochester, N. Y. They are producing nearly 50,000 per day and everything sold.

USE OF CONCRETE ON THE FARM.

Each year concrete is more extensively used on the farm—for foundation walls, for building, for cisterns, for silos, for stable floors, for walks about the house, for porch steps and numerous other purposes. It is a step that has durability and attractiveness to recommend it. When properly put down, concrete proves to be both economical and permanent.

It is estimated that concrete work for foundations, which includes both material and labor, will cost from 27 to 30 cents per cubic foot. The labor for mixing and placing concrete is about 10 or 12 cents per cubic foot. Concrete cellar floors and walks, four inches thick, cost from $1.10 to $1.50 per square yard.

The best concrete is made of Portland cement, sand and crushed rock. Sand taken from a pit is best. It should be free from such foreign matter as clay, soil, sticks, leaves or rubbish. Where much strength is required, fine, round river-bottom sand should not be used. Sand that is coarse, clean and sharp will give the most satisfactory results.

As a test of sand, rub it in the hand, and if there is much dirt left on the hand, discard that sand. If, when a handful of the same is thrown into a pail of water, it leaves the water muddy, discard it. A dirty sand makes a weak concrete. Crushed rock is much better than screened gravel because of the rougher edges. The rock sometimes known as aggregate should be broken up into irregular pieces having rough, clean surfaces.

Recommended Mixtures for Cement.

Following are the four recognized mixtures for concrete:

1. Rich mixture—One part Portland cement, two parts of clean, coarse sand, four parts crushed rock. This is used for floors, fence posts, etc.
2. Medium mixture—One, two and one-half and five parts, respectively, of cement, sand and crushed rock. This mixture is used for walks, the walls, etc.
3. Ordinary mixture—One, three, six; for heavy walls, piers, abutments, etc.
4. Lean mixture—One, four, eight; for footings, and in places where volume and not great strength is needed.

When gravel is used the proportions are one part of cement and from six to nine parts of gravel, according to the amount of sand in the gravel.

To make one cubic yard of concrete the following respective amounts of cement are required: Rich mixture, 1½ barrels; medium mixture, 1¼ barrels; ordinary mixture, 1⅛ barrels; lean mixture, ⅞ of a barrel.

In mixing a water-tight platform or a shallow box should be used. The mode of procedure is to first spread the required amount of sand in a layer, and on top of this spread the cement. Mix thoroughly while dry until a uniform color is secured. In the middle of the mass hollow out a spot, in which pour the amount of water needed, adding a little at a time, and using care not to allow the mixture to become too soft. Work up the dry material from the outside toward the center, turn rapidly with shovels, sprinkling water upon it until the proper consistency has been attained.

Important Facts to Be Remembered.

Thoroughly wet the crushed rock, and add it after the sand and cement have been thoroughly mixed. In this manner the sand grains are all covered with the finer particles of cement and the crushed rock when added has all the voids filled with the temperate mixture. This undoubtedly gives the greatest strength for material used.

A very common method, however, is to mix all three

parts at one time while yet dry, and then to mix with water until the mixture will pack well and handle with a shovel.

Measure exact amounts of each part. Mix thoroughly and not too long before applying water. Cement will set in 20 or 30 minutes, and if disturbed after that loses its strength.

Get the form walls rigid and do not use lumber that is too dry, as it takes up moisture and changes its shape so as to injure the concrete in setting.

Do not allow concrete work to dry out fast, as cracks will appear. It must be protected from the sun for three to five days and sprinkled with water to insure even setting throughout the concrete.

In two weeks concrete gains strength sufficient for ordinary use, but 60 days should elapse before it is given a full load.

sufficient water is then added to cause the sand to flow through the chutes into the barges. This process continues until the barges become filled with sand and water and the water finally flows off over the top of the barges as the sand takes its place.

Because of the water in the sand, after being conveyed to the storage bins and into the cars, there is an enormous amount of waste due to the leakage of the sand with the water. This loss is exceedingly large, especially when thousands of cubic yards are being handled—in fact, the tracks are white with sand, from the point of loading to the discharge stations.

Plans are now being perfected so that the water will be pumped from the barges and this will materially decrease both the total load to be handled and the percentage of loss.

Sand Unloaders on the Panama Canal.

In construction work, such as floors, barns, fence posts, bridges, etc., reinforcements of iron are absolutely essential. The beginner will need the supervision of an expert in using reinforcements.—Philadelphia Ledger.

RAPID UNLOADERS.

In the building of the locks for the Panama canal enormous quantities of cement, sand and crushed rock are required for making the concrete. But among these the problem of handling the sand is one of the most vital on account of the great waste entailed.

This sand is an enormous body, free from loam or vegetable matter, and is very white and sharp. It is obtained from a bar on the Pacific coast about twenty-five miles west of the city of Panama. Here it is loaded into steel barges of 500 cubic yards capacity by means of a steam-operated ladle or bucket dredge.

After being elevated by the ladle-dredge the sand is deposited into chutes leading to the barges, and

As originally planned, there were to be two distinct sand handling plants, one for each terminal. But since the partial failure of the sand handling plants for the Atlantic division, extra duty has been imposed on the Pacific division and these cranes are now handling the majority of the sand being used on the Isthmus.

The cranes have a span of fifty-five feet from center to center of tracks, and the trusses are high enough to pass over double storage bins under which the locomotives and cars pass for loading, and the cranes are sufficiently high to allow the storage of sand four feet above the top of the bins.

The barges are brought alongside of the dock by tugs and are then anchored to the piling before the work of unloading them is begun.

The cranes have a cantilever extension of thirty-three feet beyond the center line of the rail next the water, thus enabling the operator to cover the sand over the most remote portions of the barge.

The grab-bucket used for this work is of the four-

line cram shell type and weighs 1,000 pounds empty. Its normal capacity is 3⅝ cubic yards of sand and water.

All the movements in one machine are controlled by one man located in the operator's cage on the shear leg next to the water. This enables him to watch the movement of the bucket in every position for loading into the barge and discharging into the bins. The machines are so designed that the various movements can be performed separately with any other movement.

When the bucket has reached its highest position it is sustained by an automatic mechanical brake until the bucket has reached the top of the bridge, when a reversal of the hoist motor automatically releases the clutch and allows the load to be taken on the back wheels, which are automatically controlled.

The three Cleveland crane sand unloading machines on the Pacific division have a capacity of 5,000 cubic yards of sand in eight hours. This is so much in excess of what has actually been used that the storage piles are increasing very rapidly and it will be a matter of a few months until the large amount of sand storage on hand will compel them to discontinue operations until some of the material is used.

These sand unloaders are the most rapid handling plants on the Isthmus and were especially designed for the work of this company. In addition to these special sand unloaders the Cleveland Crane & Engineering Company designs and manufactures all classes of overhead electric traveling cranes, gantry cranes, transfer tables, locomotive cranes, ore bridges and electric hoists—in fact, any kind of machinery for handling material either in the cut or finished state.

CEMENT BIDS FOR PANAMA CANAL.

Bids were opened in Washington September 3 for furnishing the cement required to complete the canal, estimated at 1,000,000 barrels, more or less. As previously noted in this journal, only two tenders were received. The manufacturers of Alpha and Lehigh cement, combined, offered to supply their products at $1.51 per barrel, in barrels, and $1.91 per barrel, in bags, the price in bags to be subject to a rebate of 10 cents a bag, delivery to be made at Jersey City, or Santa Cruz, California. The Portland Cement Company offered to supply their product at $1.97 per barrel, in bags, only, subject to 10 cents rebate per bag, delivery to be made at San Francisco.

The "Canal Record" states that in connection with the advertisement for proposals, a letter was received from the Atlas Portland Cement Company, the former contractors, offering to continue deliveries as may be needed to complete the work on the canal, at the price obtaining under their former contract. Under the contract referred to, cement was supplied to the Canal Commission at the rate of $1.60 per barrel, in bags, from which there was deducted a credit of 68 cents, representing the value of eight sacks to the barrel at 8½ cents each, making the net price per barrel 92 cents.

The Alpha and Lehigh manufacturers were the lowest bidders of the two above mentioned, and, on the basis of their bid of $1.91 per barrel, in bags, less eight sacks to the barrel, amounting in value to 80 cents, the net price to the Canal Commission would be $1.11 per barrel, or 19 cents more per barrel than the price named in the Atlas company contract.

The chairman and chief engineer has recommended, subject to the approval of the Secretary of War, that a new contract be entered into with the Atlas Portland Cement Company, to supply all cement required to complete the Canal.

CONCRETE ROADWAYS.

To disseminate information and data regarding concrete pavement and concrete bases for permanent roads, the Western Portland Cement Manufacturers' Association has planned to open a bureau in Portland, Oregon, and other cities of the Pacific coast in the near future.

This information was brought to Portland yesterday by P. W. Rochester, manager of the association, who was in the city a short time on business. "It is the plan of the association to conduct a dignified campaign of education in Portland," he said. "The association has nothing whatever to do with cement prices or the marketing of the product, but deals with the good roads feature of the cement business. I have just returned from a trip through the East, on which I inspected Eastern roads. I found that the practice of building roads with concrete bases is becoming general in many of the Eastern States, and I believe that the West will fall in line to just as great an extent.

A Locomotive Crane is here employed for handling rock. The rock is loaded into 12-yard Western Air Dump Cars.

In Delaware, New York, Pennsylvania, Ohio and other states the concrete-base road has been established as the standard. Many of the greatest highways in various parts of the East which have recently been built, or which are being built at present, have the concrete base, which has been established because of its permanence.

"In the West there is much talk about good roads. Roadbuilders, however, are overlooking the important essential of standardizing the roads. In California an advance step has been taken by the issuance of bonds for 60 miles of the concrete-base roads. In Washington the counties of King, Pierce, Skagit, Lewis, Kittitas and Franklin have been experimenting and are now building some of the concrete-base roads. There are one or two counties in Idaho which are doing the same. This, I hope, will break the ice and cause other states of the West to take up the same concrete-base ideas.

"Oregon has not yet awakened to the advantage of permanent highways, but I believe it will in the future.

"It is a business proposition as intricate as the business of housebuilding. When a city issues bonds to erect a building, it does so with the idea of having the building still intact when the bonds expire. The same should be true in road building. At the present time there is not another city in the United States, the size of Portland, which is not using concrete for the base of city streets."

METHODS AND COSTS OF APPLYING STUCCO WITH THE "CEMENT GUN."

By R. C. Hardman.

The writer recently has had occasion to use the "cement gun" for placing stucco on the exterior of a small frame building, containing 631 sq. yds. of surface and having 56 door and window openings. He gives below the methods and cost of doing the work.

The building, which is two stories high, consisted of a main front with two rear wings, in the space between which the gun was stationed, with the sand and cement storages immediately behind. The typical force in the operation of the gun was one man running the engine and gun, two men mixing and sacking dry material and charging hopper, one nozzleman, one laborer to help nozzleman, and two laborers cleaning grounds and screeding.

The entire building was first covered with cheesecloth, then with a cheap grade of building paper secured by laths running vertically on the studs. This was then covered with mesh reinforcement secured by 1½-in. staples. Grounds were placed on alternate studs to give a stucco thickness of 1¼ in. The panels thus formed were filled alternately to within about ¼ in. of the face of the grounds. The grounds were then cleaned off with a small trowel and about thirty minutes later the stucco was brought flush with their face and screeded off. The screeding was done by unskilled Mexican labor with a straight-edge shod with steel. When these panels were set the grounds were removed and the panels between were filled in the same way. The work was done in four sections vertically. The top section was done first so that falling material might find a lodging place below. When a section was completed it was lightly sprayed to secure uniform color and cover up joints. The mixture used throughout was one part of portland cement to three parts of sand.

In shooting the mixture onto the wall the nozzleman stood so that the nozzle was from three to four feet from the wall, and kept the nozzle in continual motion so as not to pile up too much mortar in one place. In accordance with the principle of the device, the dry mixture was mixed with water at the nozzle. The amount of water used was just enough to keep the mortar below the runing point. Water was delivered at about 40 lb. pressure. The air pressure used was 26 lb. A higher pressure than this caused too much waste of material (mostly sand) by rebounding and a lower pressure tended to clog the hose with dry material.

The apparatus consisted essentially of an engine, an air compressor and the "cement gun," which is a hopper, having a caisson lock, for receiving the dry material and from which it is forced through a hose to the surface to be covered. As used the outfit comprised a 4-cycle, 4-cylinder gasoline engine, connected to a 2-cylinder single-acting air compressor by means of belt and pulley operated by a belt tightener. On the front end of the engine and operated by its flywheel was a small water pump for the engine water-cooling system. A second water pump attached to the compressor and operated by its flywheel was available for pumping water to the hose nozzle. Neither of these pumps was used, as the water pressure from the mains was sufficient.

Connected to the air compressor was the hopper or "cement gun" proper. This consisted of two connected air chambers—upper and lower—each closed at its top by a flap valve hinged to swing downward by gravity and closed by outside levers. The feeding mechanism, which consisted of a revolving slotted wheel, was at the bottom of the lower chamber and allowed the dry mixture to fall through and be forced through a hose, at the nozzle of which it was mixed with the proper amount of water.

In operation the lower chamber was first closed by its valve and filled with air. The dry mixture, which previously had been sacked for convenience, was put into the upper chamber, the upper valve closed and the air turned in. As soon as the pressure in the upper chamber equaled that in the lower the valve connecting the two chambers opened by gravity, allowing the dry mixture to fall into the lower chamber where the revolving slotted wheel allowed it to feed through into the hose connected to the bottom of the lower chamber under the feed wheel. When sufficient material had been forced from the lower chamber to allow its valve to be closed, the exhaust from the upper chamber was opened and the pressure reduced until the lower valve was held closed by the pressure in the lower chamber. The upper chamber was then again filled with the dry mixture, so that the feeding and discharge through the hose was continuous and uniform.

The feeding mechanism was operated by a paper wheel and friction disk controlled by a lever. The dry mixture passed through the feed wheel into the hose and was then picked up by air directly from the compressor and forced through the hose. The hose used was a 2-inch steam hose.

In the accompanying table is given an itemized statement of costs:

Table Showing Cost of Stuccoing 631 Sq. Yds. of Surface With Cement Gun.

		Cost	Cost per sq. yd.
Material for Lathing:			
Cheese cloth, 631 sq. yd. at...	$0.035	$22.9	
Building paper, 56.8 squares at	0.30	17.04	
Wire, 631 sq. yd. at.....	0.1278	80.64	
Lath, 500 sq. yd. at.....	5.25M	2.63	
Nails, 10 lbs., at.....	0.04	0.40	
Staples, 200 lbs. at.....	0.0425	8.50	
		$131.30	$0.2081
Labor for Lathing:			
Carpenters, 16 hours at.....	$0.5625	$ 9.00	
Carpenters, 59 hours at.....	0.50	29.50	
Carpenter helpers, 144 hrs. at.	0.375	54.00	
Laborers, 33 hours at	0.218	7.22	
Laborers, Mex., 41.5 hours at.	0.156	6.49	
		$106.21	$0.1683
Total for Lathing.....		$237.51	$0.3764
Material for Plastering:			
Portland cement, 65 bbl., at....	$3.43	$222.95	
Sand (at site)			
		$222.95	$0.3533
Labor for Plastering:			
Nozzleman, 96 hours at.....	$0.5625	$54.00	
Engineer, 100 hours at.....	0.375	37.50	
Laborers, mixing, 212 hours at	0.156	33.13	
Laborers on wall, 156 hours at	0.166	26.00	
Laborer (hose), 59 hours at..	0.218	12.94	
		$163.57	$0.2592
Fuel:			
Gasoline, 97.5 gal. at.....	$0.22	$21.45	
Lubricants		4.90	
		$ 26.35	$0.0418
Total for plastering.....		$412.87	$0.6543
Total		$650.38	$1.0307

Time: 12 days.
AVERAGE: 52.51 sq. yd. per day.

The resulting cost per square yard appears rather high, but it must be remembered that the stucco is 1¼ inches thick (the average thickness is somewhat more owing to the stretching of the cloth between studding), the cement is high in cost, and efficient labor difficult to secure. The nozzleman was an experienced man, but all other labor was unfamiliar with the work.

As the building covered was relatively small and badly cut up by openings, the results given above are perhaps not quite fair to the "cement gun" as too much time was lost in moving the hose lines and the consequent starting and stopping, which has a tendency toward clogging the feed hose. Time was also lost by the wearing out of the feed hose about a foot from the hopper, due, apparently to a whirling motion of the sand as it came from the hopper.

As has been stated, the gun was placed in a recess in the rear of the building so that the entire job was done without moving the plant. Fifty feet of hose was used and all parts were reached by running through window and door openings.

On the whole the apparatus is considered a success, certainly so if used on comparatively large surfaces where little changing of position is required. The quality of stucco secured is the principal argument in its favor.

CONCRETE SILO.

The concrete silo built by Dowdy & Son, concrete contractors of Atlanta, Ill., for A. E. Barnes, of that place, stood the test this winter—the severest season known for ensilage receptacles.

"We used ensilage clear to the wall," said Mr. Barnes, "while my neighbors were troubled with ensilage frozen from one to two feet around the inside of the wall."

The silo is one of the prettiest in Illinois and adds much to the general appearance of the barnyard. It is built of hollow blocks 8x16 inches. The block molds were made on a circle so as to get the circle perfect. No. 6 wire is used for reinforcement, alternating one wire and two wires to the rounds laid in the cement between the blocks. It is built five feet in the ground with a solid concrete foundation with a two-foot flange to prevent sagging. The bottom is of cement with a drain. Three coats of cement were used for the lining, which is three-fourths of an inch thick.

Near the top is a broad band of white blocks embellished with brownish red ones. This effect was secured by using white cement and white sand and colored cement for the red blocks. To give the whole a finished appearance the cement seams were beaded. Above the blocks are ventilating windows with a projecting slate roof.

"It has never settled or sagged as stave silo men declare cement silos do," said Mr. Barnes. "It has proved satisfactory."

"ADVANCE" PUMPS.

The latest catalog, No. K. 31, of the Advance Pump & Compressor Company, Battle Creek, Mich., contains illustrations and descriptions of centrifugal pumps. High efficiency and low maintenance cost, the company declares, are the leading characteristics of their centrifugal pumps. They are of universal application in power plants, industrial establishments and iron, steel, clay, sand, cement, gravel and crushed stone works. Send for a copy of this new catalog, No. K. 31, and mention Cement and Engineering News.

EXPERIENCE OF AN ONTARIO FARMER.

Cement silos may be built either with solid walls, or with hollow cement blocks. The former has probably an advantage in point of cost, but the cement-block wall is a better nonconductor of heat, and there is less trouble from feed freezing around the edges in such a silo. The cement-block silo here described is on the farm of R. F. Martin, Lincoln County, Ont. It is 12 feet in diameter and 26 feet high, built on a foundation trench 2x2 feet, filled in with solid concrete. The floor is of concrete, 6 inches thick, which is unnecessary, as a three-inch floor would answer quite as well, and a shallower and narrower foundation would suffice. The blocks were made by Mr. Martin with his own machine, the dimensions of each block being 24x12x8 inches in size, and weight 125 pounds. The concrete from which the blocks were made was composed of gravel 4 parts, sand 2 parts, and cement 1 part, made as wet as for ordinary concrete. At this rate, 4 cubic feet of gravel, 2 cubic feet of sand, and 1½ sacks of cement, make 8 blocks, 22 blocks being required to complete one circle, at which rate 800 blocks would build this silo to the height of 26 feet, 16 loads of gravel, 8 loads of sand and nearly forty barrels of cement being required for the walls. The foundation took 2 loads of gravel, 1 of sand, and from 5 to 10 barrels of cement. Each layer of blocks was reinforced by two strands of No. 9 galvanized wire laid in the mortar. Mr. Martin considers this unnecessary, believing that the reinforcement of every other layer would do as well.

The wall was laid by a mason in six days. One helper, and sometimes two helpers, were required in building. As for block-making, two men could make from 75 to 100 of these large blocks per day, amounting in all to about ten days' work for two men.

Mr. Martin submits the following figures as the cost of his silo:

Cement, 50 barrels, at $2.00	$100.00
Gravel, 18 loads, at $1.00	18.00
Sand, 9 loads, at $1.00	9.00
Wire (estimated), 200 pounds, at 3c	6.00
Mason work, 6 days, at $3.00	18.00
Ordinary labor, 30 days, at $1.50	45.00
Total cost	$196.00

It is the intention to run the walls up somewhat higher than they are at present. It has given fairly good satisfaction, but would be better for plastering on the inside. The appearance of a block silo is decidedly more pleasing than that of solid cement concrete.—Farmers' Advocate.

DU PONT POWDER COMPANY.

The E. I. Du Pont de Nemours Powder Company has announced its reorganizations plan to comply with the dissolution decree of the federal court. This involves the creation of two new companies as follows:

The Hercules Powder Company, a Delaware company, whose total assets will aggregate approximately $13,000,000. This company will issue $6,500,000 par value 6 per cent ten-year gold bonds, redeemable at 102 per cent and interest.

The Atlas Powder Company, a Delaware corporation, whose total assets will aggregate $7,000,000. This company will issue $3,000,000 par value of 6 per cent ten-year bonds, redeemable at 102 per cent and interest.

The trust agreements under which these bonds will be issued may be inspected at the office of the Guaranty Trust Company of New York as soon as the forms of bonds are approved by the courts.

Standardization of Mortars by Tests on Sand Prisms

Committee Report by Professor F. Schule, Zurich, to the Congress of the International Association for Testing Materials.

Past research has demonstrated that the solution of the question of a standard sand is closely bound up with that of the standardization of the whole method of testing such material. The diversity of the methods employed by the use of plastic mortars in different countries led to the proposal that such standard tests should be made with prisms 4x4x16 cm. in size, prepared from a 1 to 3 mortar of plastic consistency; and that these prisms should be subjected, first to bending, and then to crushing, tests in the broken sections.

A further recommendation made, is to use a constant proportion of water with each standard sand and keep the prism immersed after 24 hours up to the time of testing. For the bending test it is desirable to state to which face the load which produces fracture should be applied. At the outset it was proposed that this should be the upper face of the moulded block, but recent tests made show beyond all doubt that the tests in which the load is applied to one of the lateral surfaces of the block is preferable.

Mr. Féret has proposed an apparatus in which the bending test can be performed under a constant moment; while the writer recommended concentrating the load at the center. In order to establish a standard method of rupture by bending, it is desirable that comparative tests should be carried out in different laboratories.

Tests made with this in view show that the values under constant moment are lower and the individual divergences are greater. According to these results, the test with the load concentrated should be preferable.

In the proposed method the determination of the mean strength was intended to be arrived at by taking only the four highest values out of a series of six. Mr. Frey, of Luterbach, has rightly observed that if this suppression of the two lowest values be justifiable in the test on machine-rammed dry mortars, for the reason that any defective manipulations would tend solely to lower the strength, the case is different with prisms of well defined density, in which the errors liable to arise from over-ramming or insufficient bending, may occur in the values which are too high just as well as in those which are too low. He therefore proposed to take the mean of all six values of a series, without omitting any. A modification on these lines would improve the method.

The desired object in the previous recommendation is not to supersede the usual methods, but, by successive improvements, to establish a standard method for testing plastic mortars.

Standard Sand.

The importance of a standard sand to secure uniformity is recognized and as the only standard sand which is prepared in a uniform manner, subjected to regular control, and easy to obtain, is the German standard sand, this has been proposed as the typical standard sand. The researches carried out up to the present have shown that the ratio between the strengths obtained with two different sands is not altogether constant, but varies slightly with different cements. Hence comparative tests should be performed on a more extended series of Portland cements in order to obtain a good average ratio of strengths.

For each sand there has to be determined the proportion of mixing water to use and the work of compressing the mortar, by determining the apparent specific gravity of the fresh mortar occupying one compartment of the mould. These determinations could be carried out in such a way as to obtain approximately the same strength from one cement with two different sands, or, which is perhaps better, in such a manner as to enable all Portland cements of different fineness and quality to be treated with ease. This latter condition seems more important than the attempt to obtain an equal strength with different sands. In conjunction with the tests on prisms prepared with German standard sand and those prepared with the local standard sand, the testing of a series of Portland cements in each country by the method hitherto usually employed as a check for cements would furnish all the elements necessary for solving the question of the uniform method of testing and that of standard sand.

It is therefore recommended that one testing laboratory in each country be invited to co-operate in studying the standard sand question by investigating its own sand concurrently with German standard sand, in accordance with the indications given above.

For testing hydraulic limes and certain Roman cements it would be useful to have a method enabling any hydraulic binding medium to be prepared in the form of plastic mortar, by varying the proportion of mixing water in a uniform manner according to the nature of the medium.

It would seem to follow, from the numerous tests made by the Hungarian committee, that the compression strength does not depend on the method of manipulation and ramming of the mortar, provided the desired degree of compactness be attained. These researches would assist in ascertaining whether the solution of the problem would not be simplified by applying Mr. Féret's proposed ratio, according to which the compression strength is proportional to the formula $[c \div (1 - s)]^2$, where c and s represent absolute volumes of cement and sand per unit of volume.

In this connection, Mr. Féret writes that an endeavor should be made to discover a formula which would enable the binding media to be distinguished without the aid of their usual names, often arbitrary and indefinite.

He considers that experimenters should be placed on their guard against one of the principal conclusions of the Hungarian Committee, according to which the compression strength is independent of the method of manipulating and ramming the mortar provided the desired degree of compactness be attained. On the contrary, it would seem to follow, from his experiences, that the prisms which contain equal weights of a given cement, sand and water at the time of rupture, do not always exhibit the same strength. This strength tends to increase in proportion as the initial filling of the moulds with predetermined quantities of mortar necessitated more energetic shaking in consequence of differences, either in the proportion of water used for mixing, or in the nature or coarseness of the sand.

The results so far observed show that the only delicate point is that of fixing the proportion of water for each standard sand, and also the question of the apparent specific gravity of the test pieces of fresh mortar; while the regularity of the results obtained in laboratories has led to the proposal that the test be confined to 3 instead of 6 test pieces.

SAND AND GRAVEL RATE.

Another contest will take place over rates on sand and gravel from the Fox River Valley district to Chicago, according to an announcement made yesterday, after a meeting of representatives of a number of sand and gravel firms in the Chamber of Commerce building, Elgin, Ill.

At the present time the shippers of sand and gravel from the Fox River Valley region pay 1½ cents a hundred pounds on consignments destined to Chicago.

The rate from South Beloit, Ill., which furnishes a large amount of sand and gravel to Chicago dealers, also is 1½ cents a hundred pounds, although the distance, when compared with some points in the Fox River Valley, is fifty miles greater.

It is contended by the Fox River Valley shippers that the existing rates give the South Beloit producers an unfair advantage, and an effort will be made to effect a change so that the Fox River Valley rates will be one-half cent less than those charged from South Beloit.

According to Walter E. McCornack, counsel for the Fox River Valley shippers, a plan of action will be decided upon within a short time.

As all the shipping points involved are within the State of Illinois, it is regarded as possible that an appeal will be made to the Illinois railroad and warehouse commission.

WHITE PORTLAND CEMENT.

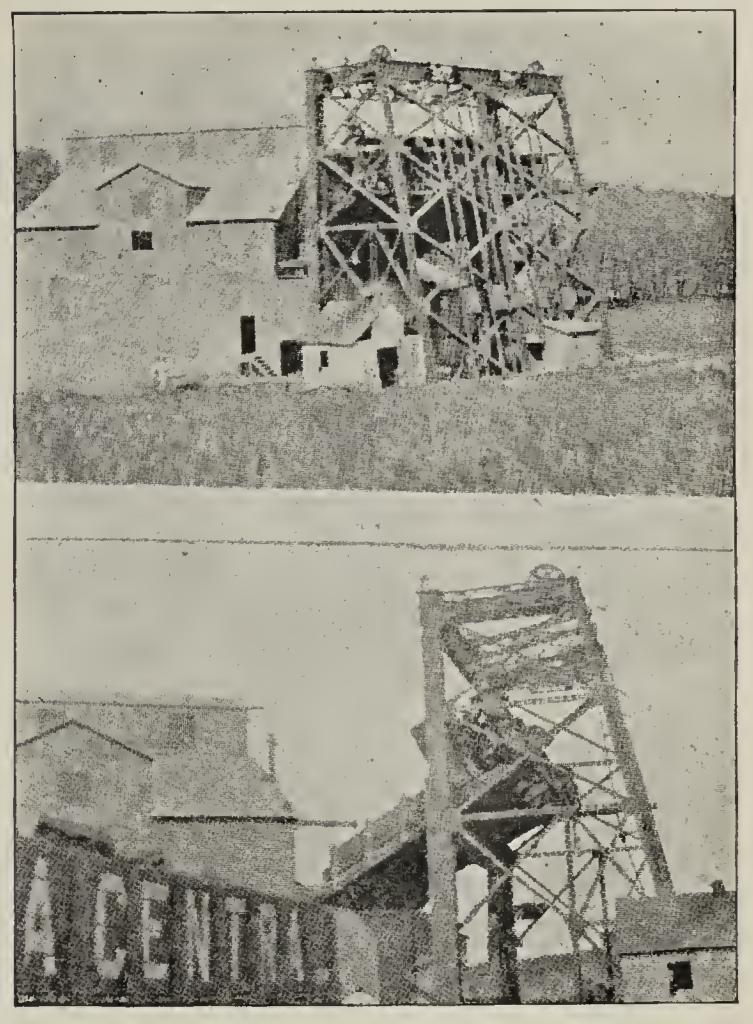
Experiments which show the value of white Portland cement as a hard finish for interior plaster have been made under the personal supervision of E. J. Alferrice, foreman for the Interborough Rapid Transit Co., New York City. Using Medusa white Portland cement Mr. Alferrice made a plaster slab, the mixture consisting of 1 part cement and 2 parts clean sand (if clear white is desired marble dust should be used). This plaster was applied ¾-inch thick as a base, and the surface was left rough enough to insure good bond for finish coat, which was made of 1 part cement and 1 part fine marble dust and 10 per cent (of the entire mix) of hydrated lime. This was applied in a thin coat and finished with a steel trowel. This left a smooth, hard surface equal to the best interior plaster, at an approximate cost for the material for the finish coat, of 12 cents per square yard for every eighth of an inch in thickness. Mr. Alferrice has been able to produce very beautiful marble effects using white Portland cement. The color effect is produced by dipping silk threads into the color desired and passing them over face of the slab after the final troweling. It is said that to insure clear lines no attempt should be made to use the trowel after the color has been applied. Samples of plaster slab have been laid up on the walls, roof and store room of the Interborough Rapid Transit Co., New York City. Mr. Alferrice used white cement all the way through this slab. This seems hardly necessary. The same result may be obtained by using gray cement with 2 parts of clean sand for scratch coat and a second coat of ¼-inch thick of 1 part white cement and 2 parts marble dust, the finish coat applied as on the slab described.

These experiments seem to open up a new field of use for white Portland cement as an interior finish material for the walls of churches, hospitals, school buildings, hotels and so on, as well as for kitchens, laundries, bathrooms, swimming pools and other places where a waterproof white wall is desired.—Concrete.

HANDLING CEMENT ROCK WITH 50-TON CAR DUMPER.

At one of the plants of the Iola Portland Cement Co., the rock is handled by rather unusual methods. Mammoth crushers, capable of handling a 50-ton charge, are used, and at one of the plants, the rock is carried to the crusher in a 50-ton car, and this is emptied by elevating it and turning the car over, bottom side up. The equipment was designed and built by the Brown Hoisting Machinery Co., of Cleveland, and was originally used for handling other material by a Chicago steel company, being later adapted to handling cement rock.

The plant will hoist, dump and lower a 50-ton capacity car in less than 10 minutes; the only labor required being a man to operate the hoist, which is



The upper view shows the Crusher Plant and Car Dumper with a car. Below is shown a closer view of the Car Dumper.

electrically driven, a second man to couple and uncouple the cars on the ground, and a third man on top of the crusher to signal to the operator.

The advantage in handling the rock in large quantities has been evidenced by the cost of quarrying, which for the last 10 month has been less than 12 cents a ton.

INDUSTRIAL NEWS.

The Lunkenheimer Company, Cincinnati, manufacturers of valves, fittings and other engineering specialties, is having plans prepared by B. L. Baldwin & Co., Cincinnati, and the Hooper-Falkenau Engineering Company, New York, for an extensive foundry addition to its plant in West Fairmont. The new building will be of brick, concrete and steel construction, three stories, and will contain about 75,000 square feet of floor space. It will be used for the production of gray iron, malleable and steel castings. The equipment shown in plans includes in part a modern sand conveying system, four 5-ton electric traveling cranes, eight 1-ton electric cranes and a number of hand jib cranes, two 80-ft. cupolas, eight puddling furnaces, core ovens, molding machines, etc. The company expects to have this foundry in full operation by the beginning of the spring season.

Unit Costs of Reinforced Concrete For Industrial Buildings

By Chester S. Allen.

Unit costs are in a way like strong drink, harmless where used with judgment and prudence, but likely to bring remorse and anguish where employed promiscuously. Rare and talented, indeed, is the man who possesses the experience, judgment, and intuitive sense to know when, where, and how to properly modify any tables or statements of unit costs to meet the peculiar conditions of each individual case. While the figures given in this paper are all taken from structures erected during the past two years under the writer's supervision, the wide range of territory, local conditions, and different seasons of the year under which the various pieces of work have been executed is so great as to render the information given of value only in a very general way.

As a general proposition we have found that reinforced concrete is the lowest priced fire proof material suitable for factory construction, and while it is true that its first cost will generally run from 5 per cent to 20 per cent higher than first-class mill construction, we have recently had several instances where, with lumber at a high price, reinforced concrete has worked out cheaper than brick and timber. It is especially adapted to heavy construction and for heavy loads of 200 pounds per square foot and over, where the spans are eighteen to twenty feet centers, not even timber can compete with it.

The unit costs of projected or completed buildings are commonly figured either as so much per cubic foot or so much per square foot of area occupied. Table 1 gives the unit costs both on the square foot and the cubic foot basis, together with a general description. of a number of reinforced concrete industrial buildings of different types erected during the past two years. It will be seen from an examination of this table that the average cost per square foot of these buildings, excluding the one-story structures, was $1.12, while the average cost per cubic foot was 8.7 cents. The one-story structures both had reinforced concrete sawtooth roofs, and the average cost per square foot was $1.77, while 8.5 cents was the average cost per cubic foot. The above costs are for the finished buildings, including plumbing, but do not embody heating, lighting, elevators, sprinklers, and power equipment. The cost per square foot of floor area was obtained by dividing the cost of the building by the total number of square feet of floor area exclusive of roof area, but including basement floors, and the cost per cubic foot by dividing the cubical contents into the cost of the structure.

While no coal pockets are included in Table 1 it has been our experience that above 3,000 tons capacity reinforced concrete elevator coal pockets cost from $5.50 to $7.50 per ton of capacity. Standpipes, exclusive of the foundations, average from 2½ to 3 cents per gallon of capacity.

On much of the reinforced concrete work which has been done under our supervision it has been possible. owing to the contract being either on a percentage or cost plus fixed sum basis, for us to obtain quite accurate and comprehensive cost data. This data, of course, is only of particular value where all the local color of each specific case is known, but the average results are at least interesting.

The average unit cost of the 1:2: concrete in the floors, including the beams, girders, and slabs, was $6.10 per cubic yard and for the columns $6.70 per cubic yard. Where 1:1½:3 mixture was used for the columns the average cost was $7.60 per cubic yard. This cost was made up of the items of cement, sand, stone or gravel, labor, and plant. The cement, of course, varied greatly with the demand, but the average net cost was $1.35 per barrel, including three cents for tests. The sand averaged 80 cents per cubic yard and the crushed stone $1.25 per cubic yard. The cost of labor of unloading the materials and mixing and placing the concrete varied from 65 cents to $2.90 per cubic yard. The cost of plant, consisting of freight, depreciation or rental of mixing and hoisting towers, erection of same, power and coal, and losses and waste on the small tools, ranged from 50 cents to $1.50 per cubic yard of concrete placed.

Next to the proper design of the structural features of a concrete building the economical design of the form work is of paramount importance. The truth of this statement is borne out by the fact that on the average job the cost of the forms amounts to about one-third the cost of the entire structure. On the buildings under consideration the average cost of the forms for the floors, including beams, girders, and slabs, was 10 cents per square foot and for the columns 13 cents per square foot. The lowest cost was in a building of the so-called "mushroom" or flat slab type of construction, where by the intelligent use of corrugated iron for the slab forms the cost of the floor forms, including wall beams, was 7 cents per square foot, and the highest cost was for an artistic but not elaborate overhanging cornice on a 12-story building, which was 32 cents per square foot. This last item rather forcibly demonstrates that any attempt at architectural development is very apt to be a costly proposition.

The cost of labor of making, erecting and stripping the forms varied according to the price of lumber, design of the structure, method of forming, character of the supervision and the skill of the workmen from 4¾ to 12 cents per square foot. The cost of lumber, nails, and oil divided by the square feet of forms averaged from 2¼ to 4½ cents per square foot.

The cost of bending and placing the reinforcing steel, including the necessary wire, averaged $10 per ton, the range being from $5.75 per ton to $17.20 per ton.

Granolithic floor finish 1¼ inch thick, when laid before the concrete below it had set so as to form one homogeneous slab, cost on the average of 4½ cents per square foot. When put on after the rough concrete slab the cost averaged 7 cents per square foot.

Inasmuch as the only economical design of a reinforced concrete structure is one which closely resembles that of the steel skeleton type, the relative cost of the various materials commonly used for curtain walls under the windows may be of interest. The writer has used brick, vitrified tile, concrete blocks, cast concrete slabs and solid concrete walls for this purpose.

The most common type of curtain wall has been either on 8-inch or 12-inch brick wall resting on the concrete wall beam. The average cost of these walls has been 45 cents per square foot. There is practically no difference in cost between the 8-inch and the 12-inch brick curtain wall, as the saving in material is offset by the great amount of extra labor in culling and laying the thinner wall.

An excellent and inexpensive spandrel wall is constructed by using 8x12x18-inch vitrified tile. This

is a non-absorbent wall and when properly laid in cement mortar makes a tight weather proof curtain wall. The cost of this wall averages about 25 cents per square foot. If the tile is plastered both sides the cost is about 38 cents per square foot.

Where 8-inch concrete curtain walls were cast in place after the skeleton frame was completed the average cost was 40 cents per square foot, and when poured simultaneously with the columns 48 cents per square foot. Four-inch cast concrete slabs cost about 35 cents per square foot.

While concrete blocks make a very cheap and light curtain wall, the price being about the same as for the 8-inch tile, the writer's experience with them has been rather unfortunate on account of their extreme porosity.

Where the location of the buildings have demanded special treatment of the exposed surfaces, we have generally specified rubbing with a block of carborundum. The average cost of this work has been 4 cents per square foot. In two instances portions of the structure have been bush hammered with a resulting average cost of 7 cents per square foot.

Concrete piles were used on the foundation of several of the buildings and the average cost of the piles was $1.15 per linear foot.

our experience that the cheapest column spacing for beam and girder construction is 15 feet by 15 feet and for slab construction 17 feet by 17 feet. In arriving at the most economical layout, it is always well to bear in mind that the construction which allows the greatest simplicity of form units together with the maximum number of repetitions of same is invariably the one that will work out cheapest in the end. The fact that the actual amount of concrete or steel required for a certain floor construction is less than that required in another by no means implies that this is actually the cheapest floor construction, as the unit labor of the form work may easily have been increased out of a proportion.

TABLE 1.

Type of building.	Dimensions, feet.	No. stories.	Story h't, feet.	Live load. lbs. per sq. foot.
Machine shop....	120x50	4	12	150
Cotton mill.....	550x129	2	16	75
		4	12½	150
Weaving mill....	140x60	5	12½	150
Knitting mill....	220x75	2	14	125
Factory	223x56	2	16	300 & 1,000
Weave shed.....	341x231	1	..	125
Machine shop....	220x100	1	..	...
Store house.....	181x56	4	14½	150
Store house.....	580x109	10	12	250
Store house.....				
Store house.....	256x100	12	8	150

Type of construction.	Col. spacing.	——Total cost—— Per sq. ft.	Per cu. ft.
Beam	10′0″x24′0″	$1.17	$0.09
Beam	10′8″x25′0″	.98	0.07
Flat slab.....	17′0″x20′0″	1.09	0.077
Flat slab.....	17′6″x20′0″	1.50	0.12
Beam and girder..	22′0″x25′0″	1.09	0.073
Beam and girder..	18′6″x18′6″	1.55	0.10
Sawtooth skylight.	13′0″x21′4″	1.79	0.07
Sawtooth skylight.	20′0″x20′0″	1.75	0.10
Flat slab.....	18′0″x20′0″	1.15	0.07
Beam and girder..	19′3″x19′0″	0.85	0.071
		.76	0.05
Flat slab.....	16′0″x16′8″	1.04	0.12

The most common methods of waterproofing concrete structure are by the introduction of foreign ingredients into the concrete, by the application of a compound to the concrete surface, by the use of paper or felt waterproofing and by actually grading and proportioning the aggregate and the cement.

Where an addition of hydrated lime in the proportions of 10 per cent to the weight of the cement has been used the added cost to a cubic yard of 1:2:4 concrete has been 50 cents. Patented compounds similar to Hydrolithic cement have cost from 25 to 35 cents per square foot of surface covered. On horizontal or inclined surfaces we have sometimes used a granolithic surface of rich mortar of Portland cement and sand, or Portland cement and screenings in the proportions of 1:1 laid at the same time as the base and troweled as in side walls construction. The cost of this work has been about 5 cents per square foot.

Taken as a whole, the lowest possible cost of a reinforced concrete building can be obtained only by a careful study of each particular case to determine the cheapest type of construction and most economical spacing of columns. As a general proposition we have found that for light loads with ordinary beam and girder construction the most economical spacing of columns has been 18 feet each way and for flat slab construction 20 feet each way. For heavy loads such as 300 pounds per square foot and over, it has been

A NEW METHOD OF MEASURING CRUSHED STONE.

Application has been made for a patent for a collapsible stone measuring form for use on highways. It is customary in road building to dump the stone in unsightly piles at the side of the road. In building the state roads in New York this made it difficult for the state inspector to measure the stone. It was at his suggestion that the new device was adopted. It consists of a box with hinged corners which allows it to be folded up and placed on the top of the wagon-load of stone. The driver, when ready to dump his load, simply takes off the box, sets it up and dumps his load in. As the sides of the box are beveled, when the form is removed it leaves the stone evenly piled. It holds just a half yard of stone, and the inspectors are not obliged to stop and estimate the quantity in each pile of stone, but simply pass along the road and count the number of piles.

CEMENT BLOCK NEWS.

The Wilson-Morgan Cement Block Company, Galion, Ohio, will erect a new factory.

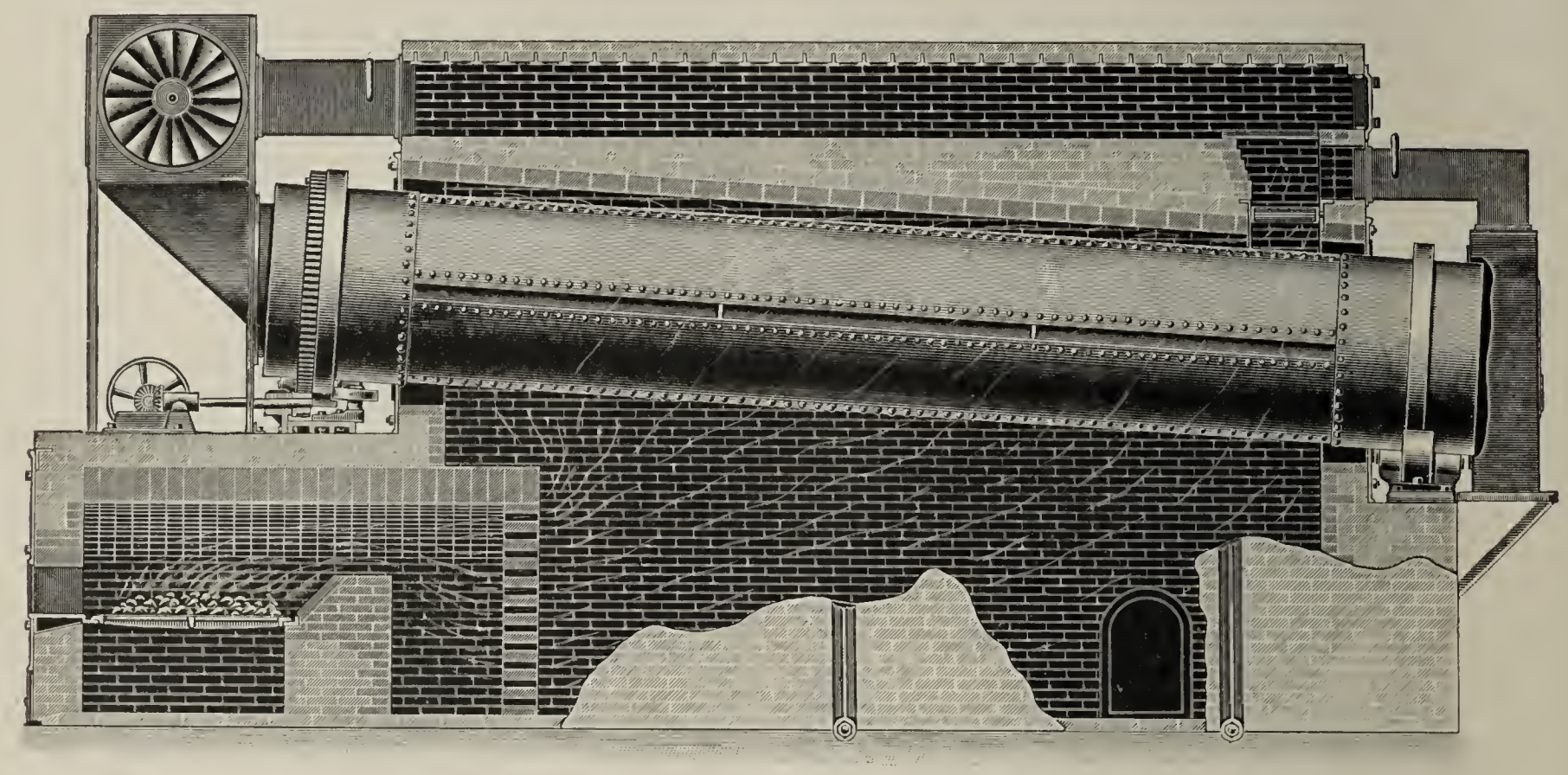
The Columbia Cement Shingle and Tile Company, a new corporation, will erect a concrete building on Columbia and Bonnell Avenues, Reading, Pa.

Imperial Cement Block Company, Syracuse, N. Y.; capital, $10,000; building materials; incorporators, J. W. Smith, W. G. Rubenstein, G. Rubenstein.

T. F. Johnson cement block factory at Sloss avenue and Sixty-fifth street, Birmingham, Ala., has been sold to Col. E. L. Higdon, who will operate on a greatly enlarged and thoroughly modern basis. He has purchased a Kramer automatic tamper. The plant is now equipped with apparatus for turning out 2,000 sizes and styles of blocks, vases, lawn furniture, columns, etc.

FOUR COMPARTMENT DIRECT HEAT ROTARY DRYER.

This dryer is made in cylinder form from forty-eight to sixty inches in diameter, varying in length from twenty feet to forty feet. Drying capacity on coal from six to fifteen tons an hour, drying it down to less than one per cent moisture. The cylinder is made of 5/16 rolled steel plates the full length of the compartment section. At each end of the compartment section are complete steel sections of one plate only ⅜ inch thick. These plates are attached to the section with butt straps and riveted with double row of rivets. The compartments are separated from each other by space channels securely riveted to each other and to the compartment plates, thus forming an air space between each compartment. Each compartment contains inter-elevators for elevating and dropping the coal through the heated air. These angles are so arranged that they can expand and contract without damage.



Style C—No. 6—4 Compartment Dryer without dust room.
Gold Medal Awarded this Dryer at Louisiana Purchase Exposition at St. Louis, Mo., 1904.

At each end of the dryer are special track rings securely riveted to the shell of the dryer, made of solid cast iron core with wrought steel tires securely shrunk on, then bolted to the same, with one-half of the thread in the steel tire and one-half in the cast iron ring. The dryer to be carried by these rings, which rests on heavy cast steel rolls finished on all sides, and supported on a heavy cast iron base, and have independent cast iron quarter bearings, the bottom half of which are bronze bushed. These bronze bushings are secured in bearings with set screws back of bearings whereby the bushings may be removed without raising the journals more than one-quarter inch. These bearings to be adjusted on bases to be secured at each corner by bearing, thus giving perfect alignment. To the cylinder is attached a cast iron girt gear riveted to the shell of the dryer. There is also driving mechanism with tight and loose pulleys.

The dryer is enclosed in brickwork, excepting the rings, trunnions and rolls, which are outside. The brickwork is built so that there is an extra return fire flue.

The compartment feature of the dryer is very important. It gives twice as much heating surface as can be had in a single cylinder. It divides the material to be dried into four parts. It also distributes the material to be dried throughout the entire cylinder, thus keeping it in balance. It also makes the dryer very much stronger.

The operation of the dryer is as follows: The material to be dried is fed in at the front end, enters the different compartments, passes through the compartments, and out at the discharge end, being continually elevated and cascaded on the way. The fire products pass on the outside of the cylinder and in the spaces between the compartments and then up through the return flue over the roof of the dryer and out through the fan and stack and do not come in contact with the coal to be dried. In drying crushed limestone or marl, the dampers may be changed so that the products first pass on the outside and in the spaces between the compartments, and then on the inside, and come in direct contact with the material to be dried. In drying coal the products of the fire should never come in contact with the coal to be dried.

In drying coal an evaporation of six to eight pounds of water can be depended upon for one pound of good ordinary soft coal used for fuel. In other words, to dry five tons of coal an hour, said coal containing twelve per cent moisture as it enters the dryer, and about one per cent upon leaving the dryer, means that it is necessary to evaporate 1,100 pounds of moisture, and allowing six pounds of moisture for one pound of coal means about 200 pounds of coal per hour for drying five tons, or forty pounds of coal per hour for each ton. There are no doubt cases where a higher percentage of evaporation can be had by excessive firing and under very favorable circumstances, but as a general thing it is better to figure on not more than six lbs. of evaporation for one pound of coal, for it must be remembered that in some seasons of the year the coal is liable to contain a large amount of ice, which makes it very hard to dry.

It is always recommended that some kind of a dust settling chamber should be used in connection with the dryer when drying coal. There are various kinds, but a serious objection to all kinds of metal collectors is that the sulphur fumes coming from the coal will

soon corrode and destroy any kind of metal. Therefore it is much better to use brick. A brick room the length and width of the dryer and ten feet high, with a hopper bottom and an automatic conveyor for taking out the dust as fast as it accumulates, is the best. It can be built on the side of the dryer or right over the dryer. It is better to build it over the dryer and thus utilize the waste heat from the dryer. It is not necessary to have any partitions whatever, simply a plain brick room with eight-inch walls.

The apparatus described is made by the C. O. Bartlett & Snow Co., Cleveland, Ohio.

THE DUST PROBLEM IN CALIFORNIA.

The question of how to handle the dust from cement plants is a vexed one in California, where the plants are situated in the locality of fruit bearing trees. A wide variety of fruit is produced in these localities, but by far the larger part of the territory is given over to orange groves, on which the cement dust has a peculiarly bad effect. On the leaf of an orange tree is a sticky surface commonly called "honey dew." This naturally holds the dust more readily than the leaf of a deciduous tree, which is dry. Furthermore, the orange tree does not shed its leaves annually as does the deciduous fruit tree.

The California Cement Company, located at Colton, has been through this fight for the last few years, the court allowing the farmers a permanent injunction against the company, with a provision in the decision allowing the cement people a reasonable length of time to install apparatus for elimination of the dust.

These people then built a large screen house, into which the gases and dust from the kilns was forced by Sturtevant fans and the dust taken out by screen plates and water sprays. The plant is now being operated under this system.

The plant of the Riverside Portland Cement Company at Riverside was also threatened with injunction proceedings to prohibit the plant from operating. When the farmers started in on these proceedings the company immediately took measures to buy up the orange groves and other land near the plant, and obtained leases where possible, so that now it has in the neighborhood of 2,000 acres of land surrounding the plant. This, of course, has been very expensive to the company, but was the best protection which it could secure until such time as a dust apparatus could be perfected.

At the same time, the company steadily experimented with various devices to remove the dust from the kiln gases. Numerous water spray schemes were tried, but the expense of operation was found to be a heavy burden on the plant. Contracts were therefore entered into with the Western Precipitation Company for the installation of one of their dust treaters. From this first treater this latter company has developed a system of dust separation, which will separate the dust in the dry state from the gases. The dust so collected is returned to the kiln bins.

In a recent test made by the Farmers' Dust Association, wherein their expert was allowed to test the apparatus, he testified that this treater was showing a clearance of 98 per cent and the small difference between this and a perfect separation was so small that it would not be noticeable at all. This treater requires one man per shift to care for it and about 50 kilowatts of current per day. The saving in dust will materially help to defray the operating expenses. One of the final treaters is now in place at this plant and the steel work for the other nine is rapidly being set.

LUNKENHEIMER "PUDDLED" SEMI-STEEL VALVES.

The increasing use of high pressures and superheated steam has created a demand for something better than the ordinary cast iron, brass mounted valves.

To meet this demand, The Lunkenheimer Company, Cincinnati, Ohio, offer their line of "Puddled" Semi-steel Valves.

"Puddled" Semi-steel is an extremely high grade iron and steel alloy, of very close grain and great strength. It must not be confounded with the mixtures made in cupolas, where the admixture of steel with the iron is beyond control, and the resulting metals sadly lacking in uniformity.

The Lunkenheimer method is to melt the iron and steel together in a specially modified "Puddling" furnace, thoroughly mixing them during the process, and by pouring off at the proper time and temperature they secure an invariably uniform alloy.

The best grade of Lake Superior Charcoal Iron is used exclusively. In "Puddled" Semi-steel, the percentage of deleterious chemical elements is kept very low, a result which is impossible to obtain in any cupola.

By their process The Lunkenheimer Company is enabled at will to control the tensile strength at any point between 30,000 and 40,000 pounds per square inch. Ordinarily, the strength maintained is 35,000 pounds, which is over 100 per cent stronger than the cast iron used in the majority of valves, and about 50 per cent stronger than that used in Lunkenheimer Valves.

Lunkenheimer "Puddled" Semi-steel Valves have been extensively used in high pressure plants carrying superheated steam, and in other places where the physical demands on a valve are great, and in every case they have given complete satisfaction.

These valves are made in two combinations as regards the material used for the trimmings, and are designated as Combinations C and D. The object of these combinations is to suit various conditions of superheat and to meet the specifications of engineers who differ as to the metal that should be used in the trimmings. Combination C is guaranteed for 600 degrees Fahrenheit temperature and Combination D for 550 degrees. Both combinations are suitable for 250 pounds pressure per square inch.

The line includes Globe, Angle, Cross, Check, Gate, Non-return Safety Boiler Stop Valves, etc.

For extreme conditions of pressure, superheat and strain, The Lunkenheimer Company manufacture the above line made of Cast Steel, the tensile strength of which is about 80,000 pounds per square inch. For lower pressures and temperature, the line is made of a high grade Cast Iron.

A full description of these valves, together with that of the complete line of high grade engineering specialties made by The Lunkenheimer Company can be obtained by referring to their 654 page catalogue, 1912 edition, a copy of which the company will gladly send upon request.

F. A. JONES, M. E.

We are advised that Mr. F. A. Jones, of Youngstown, Ohio, consulting mechanical and chemical engineer in designing, construction and operation of plaster, mines and mixing plants, is closing up his engineering practice, having accepted a position as manager of operations for all the plants of the Kelley Island Lime & Transport Company of Cleveland, Ohio, who are one of the largest producers of lime, crushed stone and hydrated lime in the world.

Leather Belting and Its Marketing

Unusually Interesting and Instructive Address Delivered before Chicago Advertising Club.

By Frank A. Mitchell.

Advertising Manager, Chicago Belting Co.

The perfection of any useful thing is seldom the result of chance. The many public utilities which have grown common to us through constant use represent years of hard labor and struggle for those who have brought them to perfection. This is true through all industrial life, and the manufacturing firm that is today producing a product approaching perfection has behind it many years of experiment, tests, and hard work.

We are to discuss the problem of marketing leather belting today, and in order to approach the subject understandingly a few introductory remarks relative to the construction of belting are quite necessary.

The leather belting manufacturer secures the belting hide, or butt, as it is commonly called, direct from the tanners. Tanning leather for belting purposes is a very slow process, as this leather must be tanned with pure oak bark without the use of chemicals in any form, and the leather is left about six months in the tanning liquor. Only the hides of native steers are used for the best belting.

The butt is first thoroughly scoured, set, and fleshed, and the shoulder cut off on a line 47 inches from the root of the tail. It is then curried, a process which consists of putting back the natural animal oils into the leather which the tanning and scouring processes have removed.

Now we stretch the leather, a rather delicate process, for if overstretched the fibers will be strained, and if understretched the leather will stretch when made into belting—an operation requiring intelligent supervision obviously.

The butt is cut up into sections, as needed for the various widths to be made, and these sectional pieces are scarfed on each end and joined together with cement under hydraulic pressure.

It is most interesting to note that in first grade belting the only part of the whole hide that can be used is the center of the back, a section 30 inches wide—that is, 15 inches on each side of the backbone—and 7 inches long.

I have given a hurried picture of the process of leather belt construction—just enough to give a slight idea of what belting is. The use of leather as a power transmission medium has never been equaled by any other method, and no substitute has ever been found that can compete successfully with leather. It possesses qualities inherent in the leather itself which no substitute has, and it is one of the very toughest substances known. A familiar illustration of this lies in the fact that the nails with which the soles of a pair of shoes are studded will wear faster than the leather itself.

Now in regard to placing leather belting on the market. I desire to speak impersonally, and the question to my mind which is to be discussed is a question of efficiency alone, for it must be remembered that all belting manufacturers work with the same base. I mean by this that they purchase their belting butts largely from the same tanneries. You see, therefore, that at the beginning all manufacturers have an equal chance in producing the best article. How is it possible, therefore, for one manufacturer to produce a better belt than his competitors? As I have just said, it is a question of efficiency, and I would divide this into "factory efficiency" and "selling service."

As the belting butt, starting from the basement, takes its way through the factory, it passes through many processes, goes through many machines, and is handled by many men before it finally reaches the finished roll. Assuming that every manufacturer purchases machines of equal efficiency, the question of superiority is brought down to the human factor.

There are two methods of employing workmen in a belt shop. One is to employ a certain number of intelligent foremen, and for all other work use common labor. The other method is to have fewer factory hands, one general superintendent working over a smaller number of foremen, and employing workmen of a higher order of intelligence—men who are trained and skilled in their line. The latter method appeals to me as the logical one to use.

In the producing of belting there is no one thing alone that makes perfection, but the constant and intelligent care that is given each one of the many small processes that foot up the total of perfection. To illustrate this: One factory may arrange their presses and machinery in a certain manner so that the leather is moved about the plant with the least possible loss of time and energy—a seemingly minor detail, and yet one that is first investigated by an efficiency expert. We find, too, in one factory the pressmen join the sectional pieces of leather together in the belt carefully and accurately, whereas in another plant the work is carried on in a listless and haphazard way, apparently without intelligent supervision or manual skill. All through the plant such comparisons can be made.

The shipping department as a valuable adjunct to the sales force is not universally recognized. Yet here we find the opportunity of presenting our final argument for quality, and I leave it to your judgment if the argument is not convincing.

Suppose a roll of belting is shipped to a jobber—a trial order, say. He looks at the burlapped roll as it comes into his receiving room and first notices that the burlap is of particularly durable quality and tightly sewed around the roll. When this is ripped off, he sees that under the burlap is strong corrugated board as a safeguard, while the belting is wrapped in strong, heavy wrapping paper. After this is removed the roll stands before him, and his wonder increases as he notes that the roll itself is bound by leather straps about one-half inch wide, one on each edge, so that it can be rolled over the floor without the belt itself being injured or soiled.

By the inductive method this merchant reasons that the belting itself must have been made throughout correctly and well, when such careful attention is given to the final work of preparing it for shipment. And he is right. It stands to reason that any firm that pays close attention to one minor detail has a vigilant eye on others, perhaps of themselves unimportant, but collectively the sum total of perfection.

Taking up the question of selling service, we must discuss the duties of the advertising department and sales department. There should be absolute co-operation between these two, because when all is said and done they are practically one. Here the **personnel** of

the two departments can either make or break the business. The duties of the advertising department are to secure pointers and inquiries, and pave the way for the work of the sales people, and its efficiency depends to a large extent on the methods employed. Its work is largely constructive.

To my mind there is no argument when it comes to the question of using trade-paper space in advertising a commodity like leather belting. The important thing is to choose the proper publication, for the very reason that there are so many papers covering various industries, and their circulations overlap to such an extent that it is almost impossible to tell with any certainty which is the leading paper in a given field.

It must not be inferred that I am in favor of placing all of the advertising appropriation in trade papers, because I believe that the proper distribution of this expenditure should be made to cover publicity in the trade paper, mailing folders and follow-up correspondence, and that they are all three of such importance and so related to each other that not one of them should be neglected. It has often been argued that it cannot be demonstrated that an advertisement in a trade paper can be expected to pay for itself in dollars and cents. I take issue with this, because I have proved that it can. I admit, however, that there are several publications where it may be advisable to carr an advertisement without the feeling that the actual orders will cover its cost.

There is a very peculiar idea existing in the minds of a great many advertisers to the effect that they must advertise in trade papers, not because they will receive good results, but because their competitors are doing so, and that in their opinion the editors are a "bunch of grafters" and can do them a lot of harm if they do not advertise. Within the past two weeks I have had this idea presented to me by a very large advertiser in a certain field, and am very glad I can say that I know from my own experience that there are absolutely no grounds for such an impression. There are unquestionably a great many trade papers that are carried on strictly as an advertising proposition, without any regard whatever for the reading matter, but if the advertiser wishes to use such a publication I do not see why it is not his own fault if he does so, as he has the same opportunity to investigate the paper as he has to investigate the purchase of anything else.

Mailing folders have their place, and I would give them the same consideration as advertising in trade papers. They have the advantage in that they are a little more personal, and while they may go to the same man who reads the advertisements, it is a very simple matter to enclose a postal card with the folder and make the work of replying easy, whereas the reading of an advertisement may produce interest, but often only in a passive way.

The follow-up is the third aid in the general system of selling service. It is the result of trade paper advertising and the mailing folder. These two make the follow-up system. It is out of the question here to discuss follow-up systems at any length. The main requisite of a perfect system is that it be as nearly automatic as possible.

From this discussion we find that our trade advertising, mailing folders, and follow-up are but an adjunct of the sales department, and the sales department must be kept in close touch at all times with every inquiry, and with the result of returns from the follow-up. Where there is perfect intercommunication between these two departments there is bound to be results. We may have built up a rather complicated system, but it must work out simply and easily, and be a system that will follow with thoroughness every prospect from the time a pointer is received to the time the order is either won or lost. When all is said and done, industry and patience are the two things that count.

Climbing from the foothills to the mountain top is not the jumping from crag to crag, but the slow, plodding along the rugged road that winds from the valley up the mountain side, mounting a little higher day by day, and the pinnacle is reached only by the persistent and tireless traveler.

The history of progress is the history of honest and patient labor. There is no other road to the industrial mountain top. Many have tried the crag route, and the record of their failures can be found in your morning paper 365 days of each year, and 366 days of this.

Any business organization adhering to the principle of honesty, industry and patience, will eventually climb the heights and stand ever as an organization where quality reigns supreme.

FOUR STEAMERS TO BE BUILT BY THE CANADA CEMENT COMPANY.

At a recent meeting of the directors of the Canada Cement Company, Limited, held at Montreal, the Board authorized the Secretary to give the following to the Press:

"The question of the quantity of cement on hand and the difficulties of transportation were gone into. The official figures show that on June 12th the Canada Cement Company had on hand 1,085,503 barrels of cement. On the same date unfilled orders west of the great lakes amounted to 149,214½ barrels, of which quantity 60,707 barrels were in transit. On the same date the company was short of 300 cars, and their deliveries at the head of the lakes by boat were 182,254 barrels less than the Company had planned and was prepared to ship, this shortage being caused partly by the late opening of navigation, interruptions of the Cornwall Canal, the slow despatch steamers have been receiving at the terminals, and by water transportation companies not supplying a sufficient number of steamers. Having in view the growth of the West, and to assist the transportation companies the Board has authorized the building of four steamers for the Company's use. The consumption of cement in Canada for the year 1911 was 6,309,717 barrels. The capacity of the Canada Cement Company's present mills is 10,000,000 barrels per annum, which capacity is being increased as rapidly as the market justifies."

TRADE NOTES.

The Texas Portland Cement Company, of Dallas, has been awarded the contract by the W. P. Carmichael Construction Company for 35,000 barrels of cement to be used in the construction of the dam at Austin, Texas. The Carmichael Company has the contract for this work.

The output of the Universal Portland Cement Company at Buffington, Ind., now averages over 250 cars per day. The plant is so busy that cars are being loaded night and day. Contracts for the Panama Canal supply, huge irrigations and railway orders serve to keep the big mills operating at a greater capacity than ever before.

A Modern Plant for Preparing Sand and Gravel

The increasing use of concrete has brought closer attention to and study of the relative values of the ingredients which enter into the aggregate. It is now recognized that as great care must be taken to have the materials right in the first place as that they shall be properly proportioned and mixed. This applies not alone to the cement, but to the sand, gravel and rock; hence it is becoming more and more general practice among engineers to demand an absolutely clean sand and gravel.

Since the preparation of sand and gravel for concrete mixtures has thus developed into a specialized industry, the following description of a modern gravel crushing, screening and washing plant, erected by the Niles Sand, Rock & Gravel Co. at Niles, Cal., is interesting as indicating the advancement made in the design, construction and equipment of a modern plant for this purpose.

Before deciding upon the design of the plant, Homer C. Plumer, secretary and vice-president of the company, a thorough engineer, visited practically all of the modern gravel plants throughout the East with the idea of obtaining and incorporating all the good ideas and latest improvements he could find, and after obtaining a satisfactory design for the plant, construction was begun under the supervision of Mr. Plummer, who spared neither time nor expense in making this plant one of the best built and equipped in the country. This plant has a rated capacity of 1,000 yards of screened and washed gravel per day, but produces from 1,200 to 1,500 yards per day, and is operated entirely by electric power furnished by Pacific Gas & Electric Company. The motors—10 in number and varying in size from 8 to 112 horse power—were furnished by Westinghouse Electric & Mfg. Co.

The type of plant is one where the gravel is obtained from the river bed, then elevated on belt conveyors to a height of some eighty feet, from which point it passes by gravity through the screening, washing and separating devices, finally discharging into the various bins located at the railroad track ready for loading into cars.

The gravel is taken from the river bed and banks by means of a Lidgerwood Excavator and brought to a large concrete hopper located over the main belt conveyor, by means of large steel bottom dump cars, which are operated by a hoist located on a turn table on top of the main hopper. This turn table is connected with a trestle work made portable. By having the hoist on the turn table and the trestle made portable the track can easily be changed to suit the location of the excavator in the river bed and thus always maintain a direct pull on the rope in hauling the cars.

From this main hopper the gravel is fed by an automatic feeder to the main 30-inch rubber belt conveyor, approximately 285 ft. centers. This belt conveyor operates on an incline of about 18 degrees and delivers the gravel to a cross conveyor passing over the railroad to the screens above the bunkers; this conveyor is also 30 inches in width and about 50 ft. centers, and delivers the material to a battery of conical screens.

When the material leaves the 30-inch cross conveyor just before passing into the screens it is discharged into a hopper built in two compartments and

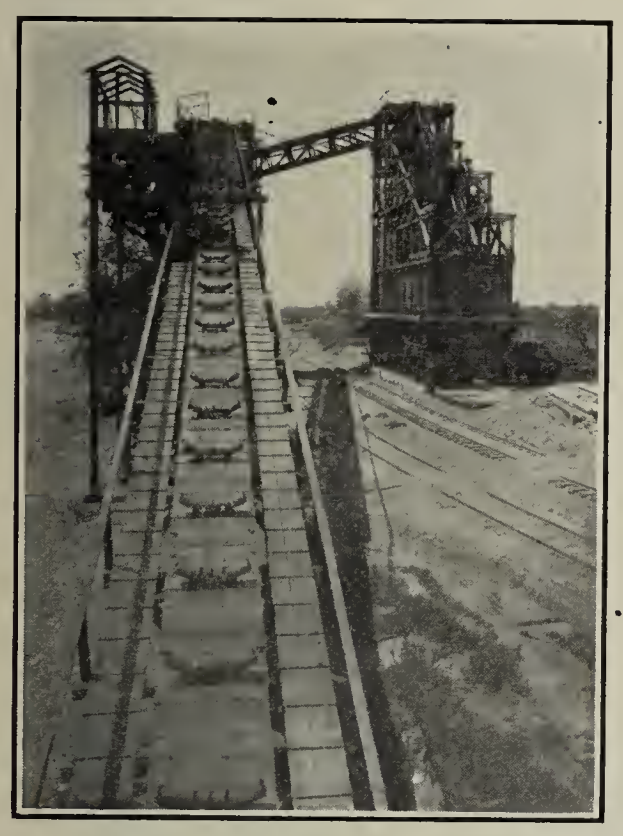
General View of the Plant of the Niles Sand, Gravel & Rock Co.

Drag Line Electric Excavator with Two-yard Bucket, Loading Sand in Cars at The Niles Sand & Gravel Pits, Niles, California.

arranged so as to split the material in two streams. The material is here mixed with water, and from this hopper the water, gravel, sand and foreign matter pass by gravity into the two first conical screens.

Above the bunkers are ten of these conical screens and also two settling tanks. After the water and gravel have been delivered into the first set of conical screens, all gravel, etc., that passes through the perforations of the screens, and also the water, is delivered by gravity through steel spouts into the small or forward ends of the next following set of screens.

Every screen is provided with a pipe nozzle extending a short distance into it, and by this arrangement all the rejections must pass through a spray of clean water before leaving the screens. These nozzles are arranged so that the water used in giving the rejections the final washing will not go with the rejections in the bins but follows and mixes the material passing through the perforations into the next screens, this process being repeated from one set of screens to



Looking Up the 30-in. Conveyor.

the next until from the last set of screens all the fine sand and water, together with all impurities which have been passing through from screen to screen are led into the separators and here the water and impurities pass off through an overflow; the sand after settling to the bottom of the separators being automatically discharged into the sand bin.

All the oversize or rejections from the first set of screens, material which needs to be crushed, pass by gravity through a steel-lined chute located between the bunkers and the conveyor trestle to the crusher bin. From the crusher bin, which is directly under the 30-inch main belt conveyor, the boulders are fed through a heavy rack and pinion gate into the crushers and after passing through the crushers the material is fed onto a 24-inch conveyor which runs parallel with the 30-inch main belt conveyor, delivering the crushed material back to the 30-inch main conveyor, and so to the screens again for separation.

Through the above arrangement the company is now obtaining five separations of clean, washed gravel, and it will be seen from the foregoing description that all material which is delivered to the plant will be washed and screened, the separators finally discharging all the fine sand into the sand bins. Nothing is wasted—even the water used in washing being piped to nearby orchards for irrigation purposes, while the dirt and impurities, being found of value as fertilizer, are used for that purpose. In loading the cars for shipment, the bunkers are provided with several quadrant bin gates with balanced car-loading chutes arranged at both sides of the bins designed so that a gate can be opened with one hand while the car-loading chute can be adjusted with the other hand. The quadrant gates are provided with cast iron hand levers and operate very easily against the pressure from the material in the bin on account of the arc of the gate overcoming any necessity of forcing the material back in the bins when opening or closing. The car-loading spouts are counter balanced, so by this arrangement the work in loading the cars is reduced to the minimum.

The Niles Sand, Gravel and Rock Company was fortunate in securing control of a large section of the river bed and adjoining lands where the deposited gravel and sand is almost unlimited in quantity and of a very superior quality, being remarkably free from foreign matter injurious to concrete. The resulting product being clean washed, dry and perfectly graded and available at a point within easy reach of the large consuming districts is the cause of the company's enviable success from the very start.

NEW STONE-SPREADING CAR.

The Port Huron Engine and Thresher Co., Port Huron, Mich., have placed on the market a stone-spreading car of original design. It is built of steel throughout, steers by hand and is reversible. The particular advantage of the car applies to its use on narrow or crooked roads where there is insufficient room to get alongside with engine or roller. The capacity of the car with top box shown in the cuts is 6 cubic yards. According to the adjustment of the doors it spreads stone over the roadway to any depth from one to eight inches, according to the adjustment of the doors. The opening of the doors is regulated by rods and chains operated by a crank device on the side of the car. The main frame is made of channel steel and

angle iron, the box of sheet steel. The wheels are very substantial and have wide tires. The spokes are set in the rim of the wheel, heavily countersunk and hot riveted. Spokes are cast into the hub and each given an equal tension. The wheels have roller bearings and are bushed with cold drawn steel tubing of standard size and interchangeable. This bushing is one continuous piece 12 inches long and can, if necessary, be changed in the field by an ordinary mechanic. Axles are of cold rolled steel, 3 inches in diameter and interchangeable; by changing them from one side to the other the wear is reversed and the length of life doubled. There is a substantial curb bumper at each end. This bumper or tongue can be made rigid by inserting a lock pin, or flexible by its removal. The hand steering wheel makes the control of the direction of the car unusually easy. In fact, the manufacturers state that it handles like an automobile, and call it the auto car.

UBBINK SIDEWALK FORMS.

Plank for sidewalk forms is getting to be a thing of the past. And it certainly should be relegated to the junk pile, when there can be found on the market such a convenient, time-saving device as the Ubbink all-steel sidewalk forms, made by Jos. Ubbink, Port Washington, Wis. These forms have rigid side pieces of No. 10 Bessemer steel, with cross pieces of No. 8 Bessemer. These latter are made adjustable to any of the standard widths of walk. Flexible side pieces for curves are also provided, these being made of No. 12 spring steel. These forms guarantee a correct expansion joint, that requires no parting sand, and it is impossible for them to get out of square. They furnish a perfectly straight edge to draw on. Groover needs only to follow line made by removal of dividing plate, which is removed first, leaving side rail in long as possible to protect edge. They are easily kept clean and can be used at least two or three times a day—on a dry day four times. They are light to handle. Mr. Ubbink makes an offer of 10 days' free trial.

PORTABLE HOIST AND DERRICK.

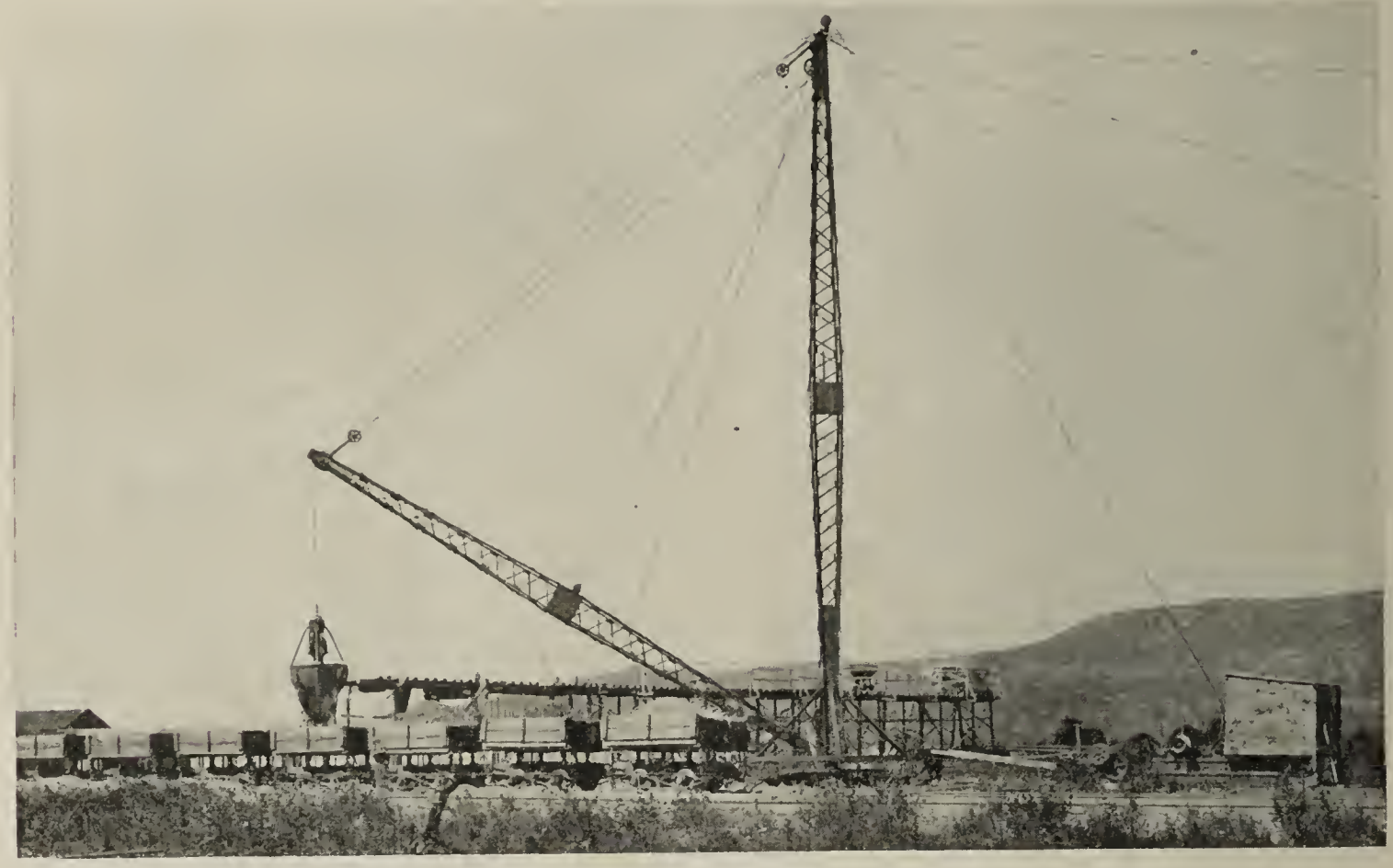
The Clyde Iron Works, Duluth, Minn., has designed a portable electric hoist and derrick outfit, which is especially suited to certain classes of yard service in industrial plants and also for construction work. The hoist is mounted on heavy steel skids which are made from 12-inch I-beams, 25 feet long, and is, therefore, entirely portable and may be moved about by its own power. The illustration below shows the steel derrick which accompanies the hoist. The derrick boom is 75 feet long, the mast being 90 feet high. The diameter of the bull wheel is 20 feet. The derrick is also mounted on steel skids made from 12-inch I-beams, 24 feet long, and may be easily moved about. It has a capacity of 10 tons and weighs complete 19,650 pounds.

The hoist has a capacity of 12,000 pounds on a single line at 144 feet per minute and is equipped with three drums, 14 inches in diameter. Between flanges the drums are 24 inches in length, the diameter of the drum shafts being 5 inches. A double cone friction with maple blocks, 40 inches in diameter, is used, the diameter of the friction gears being 42 inches with 5-inch face.

The hoist is equipped with a bull wheel swinging gear having drums 18 inches in diameter with 8-inch faces running on a shaft 6 inches in diameter. The capacity of the swinging gear is 25,000 pounds at 69 feet per minute and the length of the swinging gear frame, in addition to the hoist bed, is 5 feet.

All the levers for the operation of the hoist are placed on an elevated platform at the rear, giving the operator a full view of the work at all times. There are four thrust levers, four foot levers, three pawl levers and the motor controller lever, making a total of 12. The foot levers, as well as the hand levers, are equipped with automatic ratchet-locking devices.

The hoist is equipped with a 75 horsepower Westinghouse, mill-type, series-wound, variable-speed motor. Complete with skids it weighs 33,775 pounds.



Portable Hoist and Derrick.

PILE DRIVING MACHINERY.

Catalogue 4 from the Union Iron Works, Hoboken, N. J., is devoted to the Arnott pile driving machinery. The construction of the machines is described, the general features of the eight sizes are explained and the special uses pointed out, and there are many illustrations of the drivers in service, with notes making the pictures of unusual value to contractors.

DUMPING WAGONS.

The Glen Wagon Co., of Seneca Falls, N. Y., has issued a folder describing the Star dumping bed, built to fit any heavy wagon gear 38 or 42 in. between the bolster stakes; the Star dump box in 1½ and 2 yd. sizes, and the Star dumping wagon in 1½, 2, 2½ and 3-yd. sizes. Special attention is given to the dump box, which is offered for the heaviest class of construction work.

Let this Machine Make the Sale

By the Quality and Quantity of Drain

Tile it will turn out right in *your own plant*

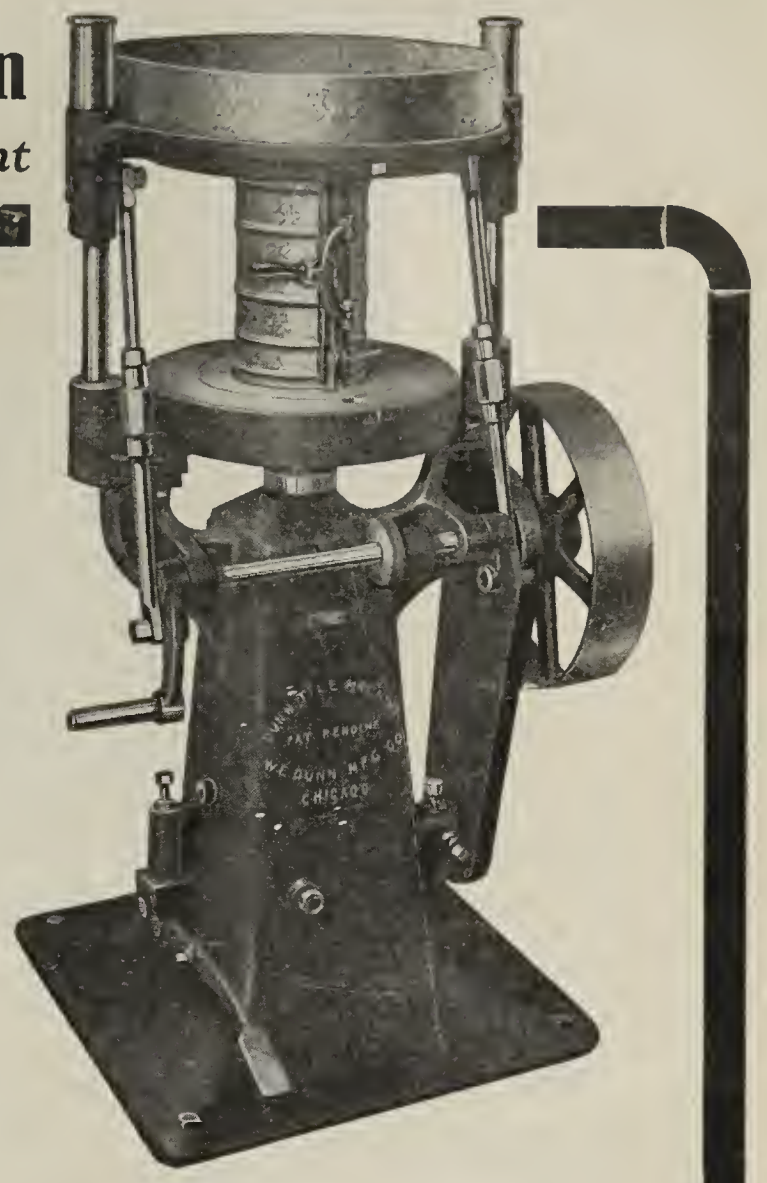
We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.



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Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.

Prices of separate molds from $3.50 up. Combinations of molds from $12.50 up. Send for a catalogue. It shows the different molds and many products they will make.

Poured Sewer Pipe Molds

No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

W. E. DUNN MFG. CO.

4139 Fillmore Street
CHICAGO

THE CONCRETE FOUNDATION FOR A LARGE OFFICE BUILDING.

The construction of the foundations for the Northwestern Life Insurance Building in Milwaukee is an interesting example of concrete work, in which the methods employed represent the most up-to-date practice in the construction of foundations for a large office building. The problem was one of completing a large and important job in a limited space of time, and called for the use of well tried-out methods, and the handling of the work in a manner that gave the least opportunity for delays.

The property on which the building is being erected was formerly occupied by a number of small stores and residences and as the ground was about eight feet higher at the rear, than at the front of the building a considerable amount of preliminary excavating was necessary. This was performed by two Marion Steam Shovels which were followed by Grab Bucket Excavators, by means of which the trenches for the foundation were dug. Four Steam Pile Drivers were used in driving the thirty-two hundred piles over which the concrete foundations are laid.

No. 1. Pouring the Concrete on the South Front of Building; Northwestern Life Insurance Building.

The placing of the concrete was started at the southeast corner, working both north and west, employing at first two, and later three mixers. All of the concrete was spouted direct from the discharge chutes of the mixers, the chutes being hung from the mixer frames. The mixers were provided with an attachment by which the discharge is controlled from the hopper side of the machinery, making it require only one man to operate the power loader and discharging

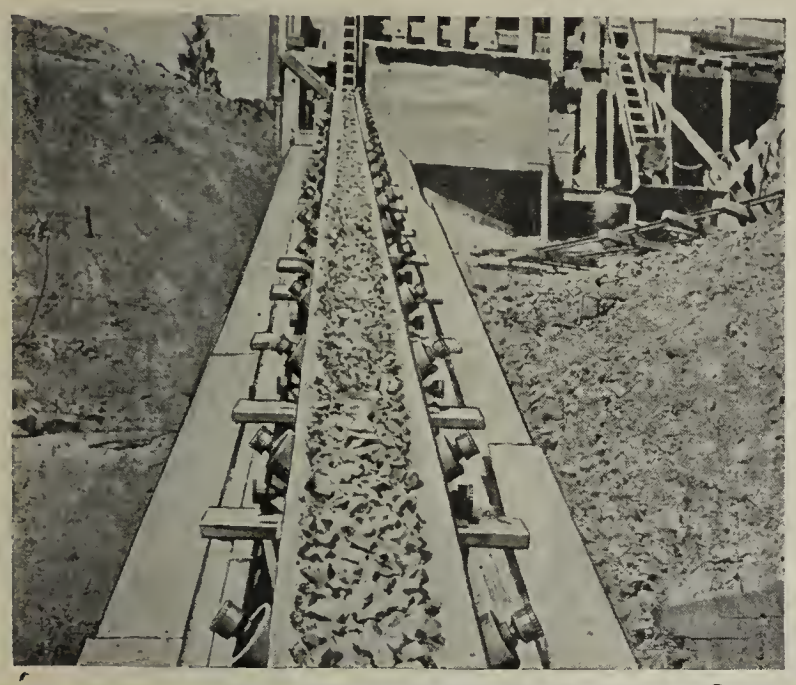
No. 2. Foundations on the East End of Building.

Gravel Washing Equipment

We are prepared to furnish Machinery Equipments for the efficient and economical handling of crushed stone and gravel, including Belt Conveyors, Open-top Carriers, Screens, Continuous Bucket Elevators, etc.

The Link-Belt Belt Conveyor

Shown in the illustration carries crushed rock from quarry and delivers to a Link-Belt Continuous Bucket Elevator, which in turn delivers to bin



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Across the whole Face of the

Jeffrey New Vibrating Screen

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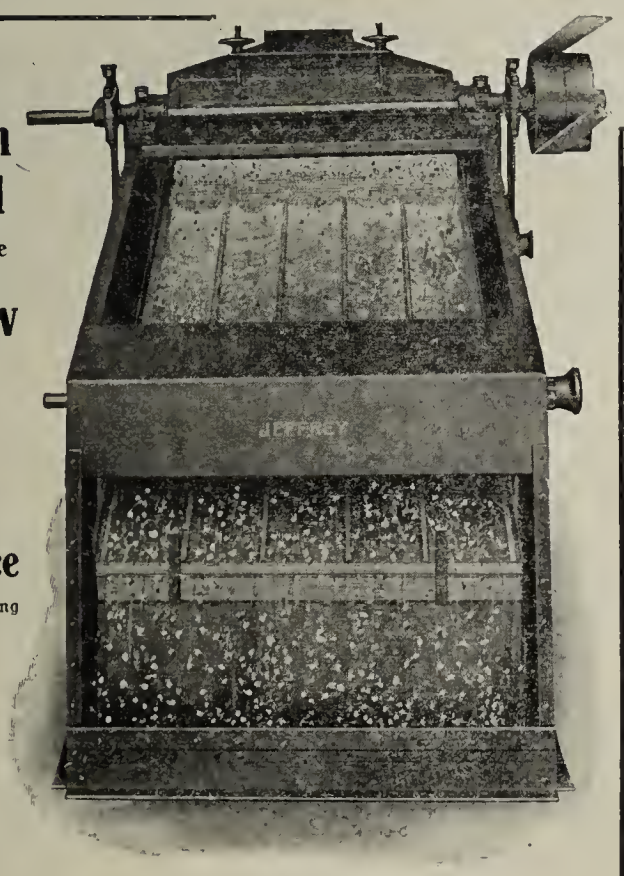
(Found on no other Vibrating Screen)



Front View of Screen with Doors Removed to Show Screening Action.

The feed can also be regulated for any desired amount (in accordance with the Character and Condition of the material to be screened and the mesh of the screen to be used).

The Adjustment can be quickly made at any time (even while the machine is running).

Bulletin No. 69-D gives full particulars, including prices and detailed information. Write for free copy. Send us your samples for test.

Jeffrey Mfg. Co., Columbus, Ohio

(11-8-12)

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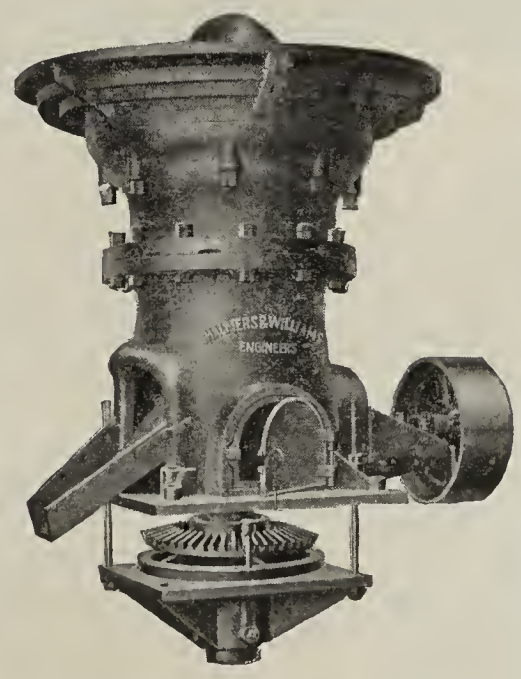

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of each mixer. The materials were delivered to the mixers in wheelbarrows from a central distributing point, and the spouting arrangement used made it possible to cover a distance of about seventy-five feet before it became necessary to move the mixer.

A large part of the concrete was placed during very cold weather when most of the material was received in a frozen condition; it, therefore, had to be thawed out before mixing and heated to a temperature sufficient to prevent freezing after the concrete had been poured. This was accomplished by providing a storage bin containing a series of steam coils, in which the material was allowed to remain at least two hours after which it had reached a temperature of from fifty to sixty degrees. The mixers were also fitted with an attachment on the tank by which a steam jet was introduced into the water, keeping it heated to a high temperature; thus all of the ingredients were heated when they entered the mixer.

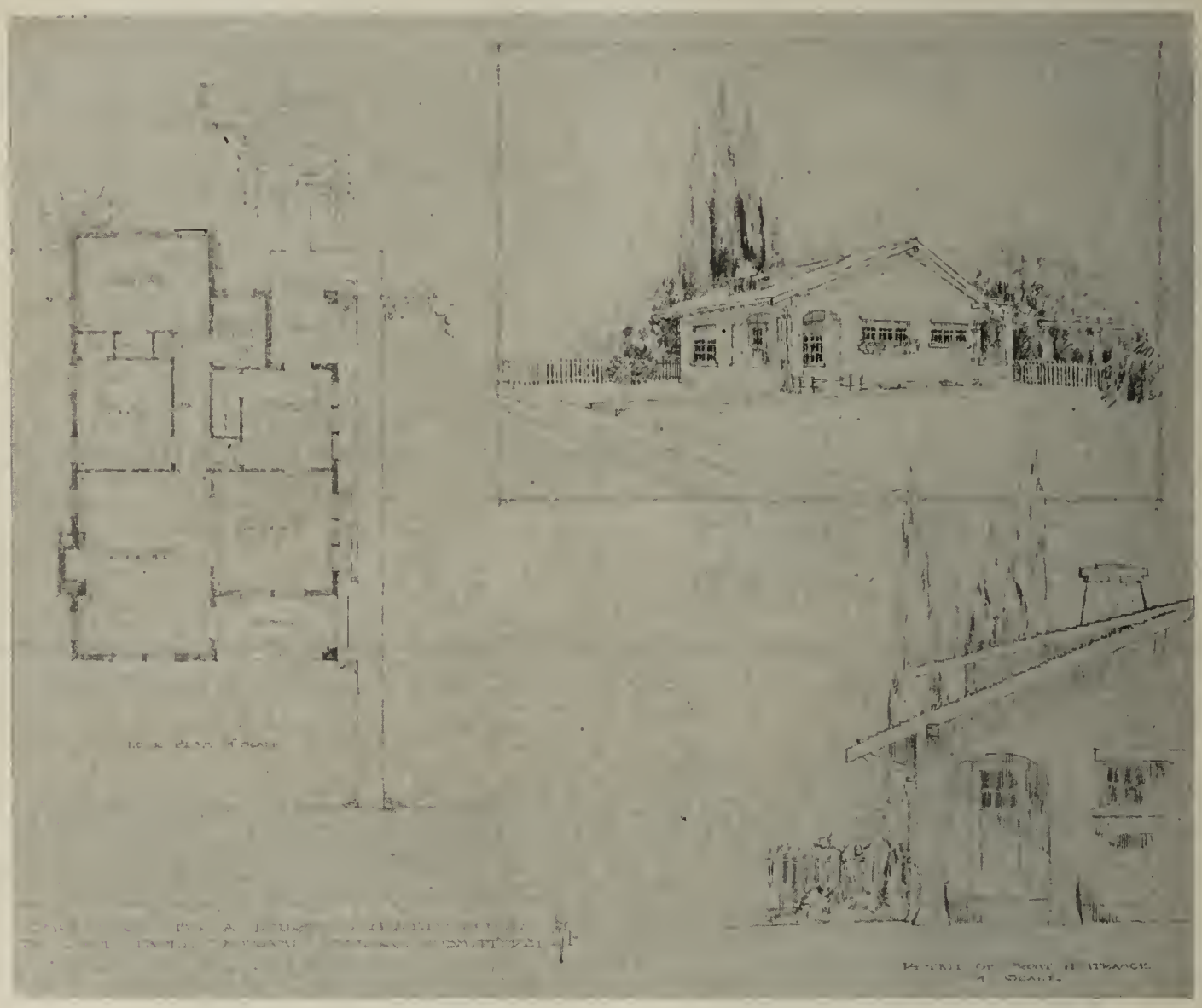
The work progressed night and day, making an unusually severe tax on the machinery, which was in operation almost continually during the entire period of pouring. The mixers averaged about one batch per minute, often working 21 hours a day. When going at full capacity, the mixers turned out a ½ yard batch in 47 seconds.

The foundations proper were poured continuously, making them monolythic, while the walls above were poured in sections. There was, however, very little delay between the pouring of the different sections, so that these also are practically monolythic.

The concrete is a 1:3:5 mixture, and the aggregate consists of crushed gravel, ¾ in. to 1½ in. A total of approximately fifteen thousand barrels of cement were used and the amount of concrete in the finished foundations will amount to in the neighborhood of twelve thousand cubic yards. The work is being done by the Hedden Construction Company of New York City.

SAND-LIME BRICK NEWS.

The Opelousa Stone and Brick Company is the name of a new concern which has been organized to manufacture brick by the sand-lime process at Opelousa, La. The company is capitalized at $25,000. Oscar Daspit, of Baton Rouge, is at the head of the organization.



Plans for Concrete Houses.

An architectural competition properly conducted brings out a great deal of original thought on the part of the draftsman. It is one of the best methods for obtaining the original ideas of the best thinkers.

Some time ago the Blaw Steel Centering Company offered prizes for the best plans and specifications for small, concrete residences, costing not to exceed $3,000. The idea being to provide a design suitable for any ordinary location, adaptable to any climate, and to have the walls made of poured concrete, reinforced if necessary. The balance of the design was left entirely to the judgment of the draftsman.

From a large number of plans submitted, Professor A. D. F. Hamlin, of Columbia University, selected the six best plans and awarded the prizes to them. These six, with a number of others of meritorious design, have been incorporated into a neat book. There is also included, suggestions for specifications for buildings with poured concrete walls in which the well-known Blaw Centering can be used. The book is practically an authorative treatise on this form of construction and will be of interest to the contractor erecting concrete houses, as well as the designer who is consulting his client's wishes.

We understand that the Blaw Steel Construction Company, Westinghouse building, Pittsburgh, Pa., will send one of these books to such of our subscribers as write to them for it. The plan shown above was awarded fourth prize and was submitted by Everett H. Crabb, 904 State Life Bldg., Indianapolis, Ind.

THE MISSABE DIPPER.

The Edgar Allen American Manganese Steel Company, McCormick Building, Chicago, Ill., have just issued their Bulletin, No. 51, describing and illustrating The "Missabe" Dipper (patented) for steam shovels and dipper dredges.

This is a valuable Bulletin for contractors and others who use steam shovels and dredges and will be sent gratis to those interested.

Conc. Mixer, Sizes 7 to 40 Cu. Ft.

Continuous Mixer
Price Complete, $292.50

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Buy your machinery from the largest concrete machinery plant in the world and get the benefit of factory prices. We guarantee a saving of 15 to 50% with ten days returnable privilege if moulds are not entirely satisfactory; freight charges paid by us.

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Block machines, all types, styles and sizes	Porch columns	Block cars
Brick machines	Railings	Cement finishing tools
Cap and sill moulds	Balusters	Rollers
Fence post machines	Newels	Waterproofing
Drain and sewer pipe moulds	Ball moulds	Concrete floor dressing
Lawn vases	Chimney moulds	Rock crushers
	Coping moulds	Cinder crushers
	Sun dials	
	Jardinieres	
	Flower boxes	

and dozens of other articles too numerous to mention. Our line of concrete mixing machines includes everything from small hand type up to the largest power machines made with any kind of equipment desired.

Pipe Moulds

Brick Machine with or without Tamper

Send for catalogs today, advising what you are interested in

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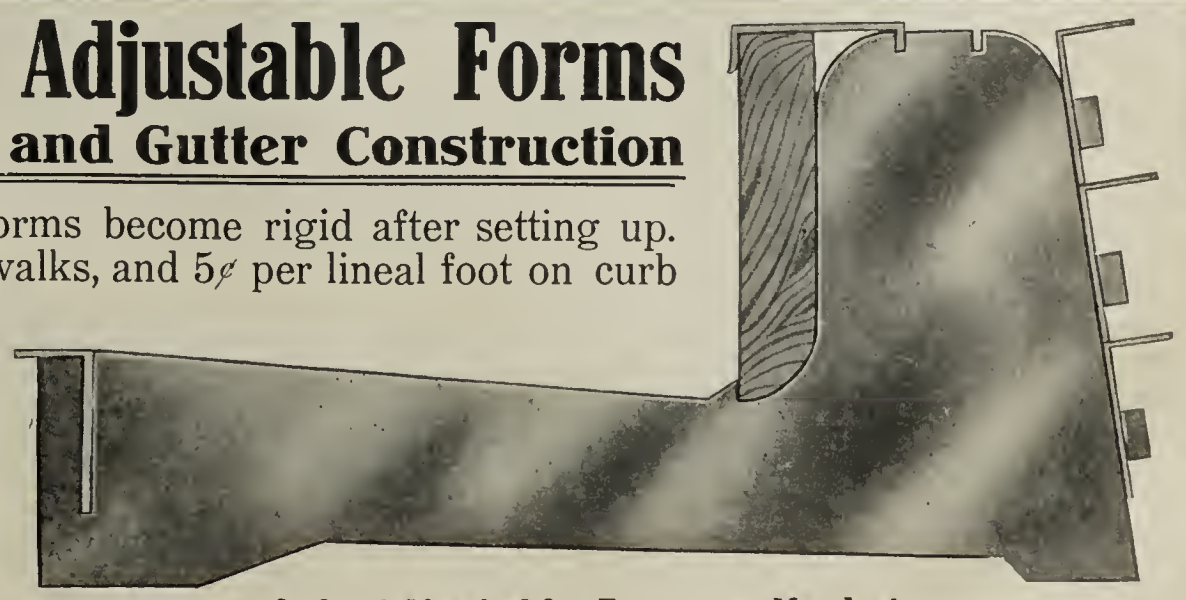
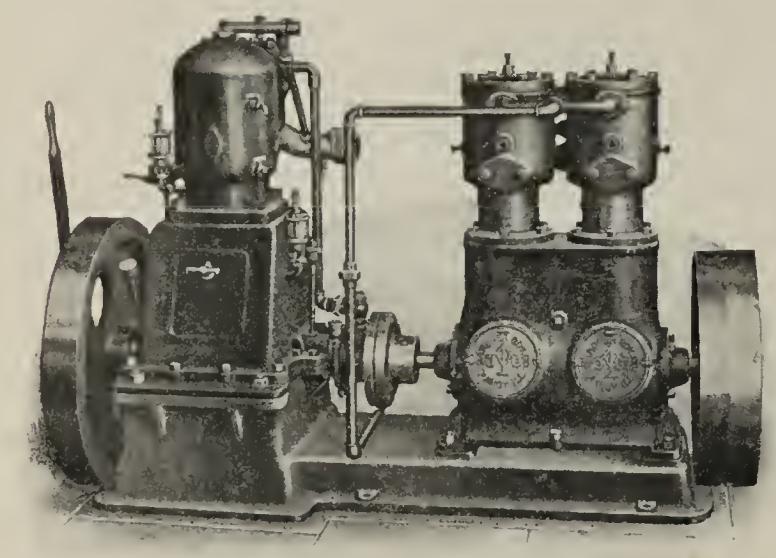


Only Adjustable Form on Market

GAS ENGINE DRIVEN AIR COMPRESSOR.

In addition to the motor driven portable air compressor which they have been building for many years the Gardner Governor Company, Quincy, Ill., is also building a line of gas engine air compressors. These consist of a vertical Gardner-Rix high speed air compressor connected to a gas engine either directly or through a belt connection. These units are furnished in both stationary and portable styles, the former being illustrated herewith.

The outfit illustrated below consists of a 6x6 in. class H duplex compressor directly connected to a vertical gasoline engine. Both of these are mounted on one common bedplate, which gives a compact and light unit. Among the advantages claimed for the compressor are the use of few parts, freedom from outside adjustments, simplicity of construction and the requiring of but little attention to keep it in good working order. It is emphasized that the freedom from intricate mechanisms requiring delicate adjustments makes it a valuable compressor for use in places where the best care and attention are not always available. The compressor is of the inclosed type and is dirt and dust proof and is capable of being operated at high speed. This feature is possible for several reasons; among these are the use of a special type of valve, large valve openings and air passages, automatic



Gas Engine Driven Air Compressor Outfit, Built by the Gardner Governor Company, Quincy, Ill.

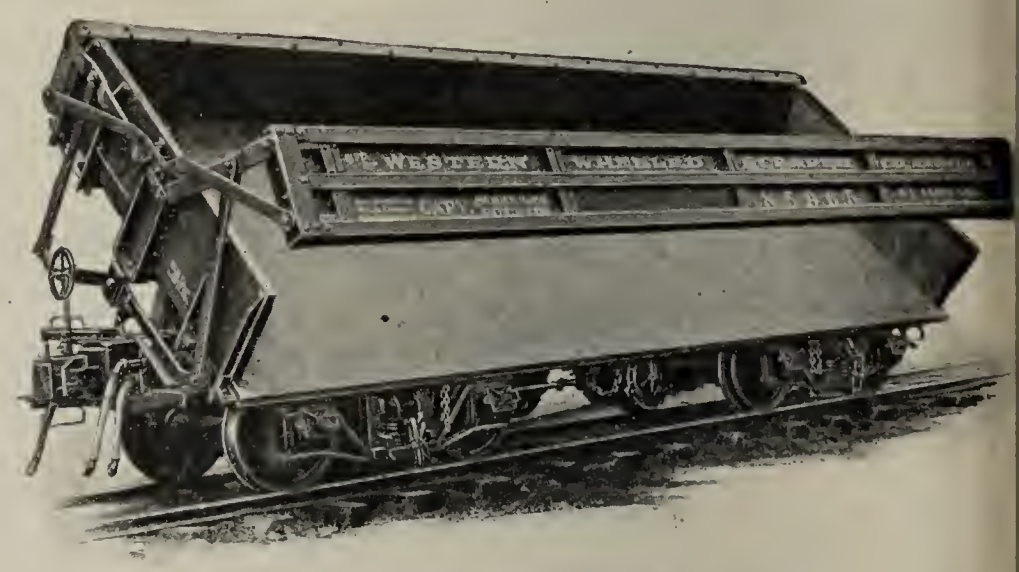
lubrication and the use of a trunk piston. The valves instead of being of the poppet type or heavy flat valves are very light. Tempered sheet steel not over 1/50 in. in thickness is used and it is emphasized that in this way the continual seating causes no wear on the cylinder or piston. By making the valve areas large and the air passages of ample proportions it is pointed out there are no cramped openings, and as a result friction is eliminated.

The lubrication system is automatic and uses a combination of grease and oil. It is emphasized that every part subject to wear is given a good supply of lubricant and as a result the bearings run cool and do not wear rapidly. Compression cups on the connecting rod are employed and aside from these there is no necessity for lubrication, grease or oil cups.

The piston is of the trunk type and as a result the cross-heads and stuffing boxes are entirely eliminated and there are no stuffing boxes to pack or cross-heads to key up. The connecting rod and the main bearings are all fitted with interchangeable die cast bushings which are easily renewable. When these become worn no rebabbitting is necessary, as all that has to be done is to slip out the old bearings and insert new ones.

NEW CATALOGUE OF A STANDARD LINE.

The Western Wheeled Scraper Company, Aurora, Ill., sends out a recent catalogue of 128 pages devoted to the various lines manufactured by the company, such as scrapers, dump cars, elevating graders, wagons and road machinery. This company has been known for a number of years very largely through its dump cars, which are in use all over this country and



in many other countries. Its cars are made in a variety of styles, including all steel cars with air dump, and in sizes from 1¼ yards to 30 yards. The line of portable rock crushers will also be of interest to the readers of this paper.

GOOD CONCRETE FLOOR SURFACE.

A surfacing machine for concrete floors which is easily handled and at the same time rapid and covering a large amount of surface is that made by M. L. Schlueter, patentee and manufacturer, 103 N. Canal street. Chicago. This machine is operated by a very light touch. It has blocks 12 inches in diameter to which carborundum blocks, or blocks of any other material, may be readily clamped. It is operated by ¾ h. p.

motor and pressure from 5 to 100 pounds may be obtained on each block. It is susceptible of a quadruple motion, thus insuring an even polishing of the floor surface. It is also adaptable to mosaic tile floors or concrete floors, in which granite or marble chips have been used as an aggregate. The varying density and hardness of the materials which compose such a floor make it unusually difficult for a surfacer, but this machine gives it a smooth, even polish without any difficulty.

CEMENT

... AND ...

ENGINEERING NEWS

AN ENTRANCE DETAIL.
(Courtesy of the Architectural Record, N. Y.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY

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CHICAGO, DECEMBER, 1912

STONE BREAKS RECORD.

Seventy-seven Million Dollars' Worth Produced in 1911—Pennsylvania Greatest Producer.

Stone quarrying is one of the ten greatest mineral industries of the country. In value the product is exceeded only by coal, iron, clay products, copper, oil, and gold. A statement just issued by the United States Geological Survey shows that in 1911 the value of the stone products in the United States was $76,966,698, a record-breaking figure. The stone industry has made rapid strides since 1900, as is shown in the following table:

1901	$47,284,183
1903	57,433,141
1905	63,798,748
1907	71,105,805
1909	71,345,199
1910	76,520,584
1911	76,966,698

The following figures show the values of the different kinds of stone marketed in 1911:

Limestone	$33,897,612
Granite	21,391,878
Marble	7,546,718
Trap rock	6,399,622
Sandstone	5,854,395
Bluestone	1,876,473

Pennsylvania was the greatest producer of stone in 1911, with an output valued at $8,147,505; of this more than $5,000,000 is credited to limestone. New York came second, with a total production valued at $6,895,466. The following States may be considered leaders in 1911, each having produced stone to the value of more than $2,000,000:

Pennsylvania	$8,147,505
New York	6,895,466
Vermont	6,145,351
Ohio	5,796,829
California	4,676,902
Indiana	4,413,655
Massachusetts	3,846,211
Illinois	3,467,930
Wisconsin	2,375,102
Missouri	2,338,585
Maine	2,257,034

Statistics concerning the stone industry in its various phases are contained in a report on stone by E. F. Burchard of the United States Geological Survey, now on the press as an advance chapter from "Mineral Resources for 1911." The report includes, besides a large amount of tabular data covering production by States and counties, a general discussion of the stone resources of the United States. This portion of the report is illustrated by seven maps which show the location of stone quarries by types of stone in all the States east of the Mississippi.

A copy of the report, which will probably be issued sometime in November, may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

CONCRETE HIGHWAYS.

Every person interested in the good roads movement is aware of the latest development in this important work through the use of concrete. This new type of road is now the subject of extended experiments by the United States Government. It has met with such pronounced success in Wayne county, Michigan, as to give that locality national celebrity. In brief, a concrete road is akin to our cement sidewalks, a water-shedding, indestructible and monolithic mass that defies disruption.

The Association of American Portland Cement Manufacturers has published for free distribution a comprehensive book entitled "Concrete Highways," which will interest road supervisors, contractors and taxpayers in every section of the country. The book, which is handsomely and profusely illustrated, contains nearly a hundred pages. It was prepared by expert road engineers and goes into every detail of construction, concluding with a tabular digest of concrete pavements in all sections of the country. The various chapters include discussion of bituminous compound wearing surfaces, grouted pavements, reinforced concrete pavements and specifications for the one and two-course types. In fact, the book covers the entire subject in the most reliable and authentic way. Road supervisors, especially, will find it of inestimable value and the tax-payer will be extremely interested in the economical results obtained by the introduction of these durable concrete highways. Free copies of the book may be had upon application to the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa.

RAPID QUARRYING OF LIMESTONE.

The Cumbler Estate has installed a large new steam drill at their limestone quarries near Steelton, Pa. This will be used in drilling holes six inches in diameter through the limestone rock to a depth varying from 75 to 125 feet. These holes will then be charged with an improved blasting powder, and a battery of such holes will be fired simultaneously. Each blast of this kind removes from the face of the limestone cliff a mass of rock estimated to weigh from 40,000 to 60,000 tons. Owing to the scarcity of laborers at the quarries a large steam shovel has been installed to facilitate the loading of the blasted stones on railroad cars.

AN AMERICAN CONCRETE PLANT USING THE CENTRIFUGAL PROCESS.

A plant, for the manufacture of reinforced concrete poles, pipes and ties, by means of the centrifugal process, is at present being conducted on a commercial basis in Los Angeles, Cal. This process was patented in Germany in 1906 and the patent rights of manufacture for this country, Canada and Mexico are held by the Centrifugal Concrete Co. of America, of which Mr. E. Rabin, of Los Angeles, is president.

The Los Angeles plant is operated by a subsidiary company known as the Centrifugal Concrete Co. of Los Angeles, and is located on an eight-acre site at Twenty-third street and Long Beach avenue. It is equipped with machinery imported from Germany, and its present capacity of output ranges in size from 6 in. to 30 in. in diameter and in length up to 75 ft. Additional equipment of double the present maximum diameter will shortly be installed, and will be used in the manufacture of sewer pipe and water mains.

The process itself consists essentially in rotating molds containing concrete at a high rate of speed, thereby utilizing the resulting centrifugal forces to squeeze out the water and compact the mass, and where desired, cause it to assume a hollow shape. This rotation is followed by a rest in the molds for a day and then curing in a reservoir of water for the required time.

It is claimed that concrete piles, made by this process, of crushed granite, are in no way affected by sea water and also that concrete supports suitable for mine work similarly made may be used in copper mines without fear of deterioration from the corrosive action of the mine water.

The company is at present making 2x2 in. hollow fence posts of reinforced concrete suitable for holding barbed wire, and under special patents they propose to manufacture hollow reinforced concrete track ties.

A second subsidiary company to the Centrifugal Concrete Co. of America is the Class A. B. C. Construction Co. of Los Angeles, organized to erect buildings of concrete units made by the centrifugal process. For this class of construction standard units analogous to steel standards will be manufactured at the plant and hauled to the building site. There they will be assembled and joined by means of projecting reinforcement bolts and plates, and it is claimed that by this method of construction buildings may be dismantled when desired and rebuilt elsewhere.

CONCRETE CONSTRUCTION—METHODS AND COST.

The new book just issued by Halbert P. Gillette and Charles S. Hill, entitled "Concrete Constructions—Methods and Costs," is unique among all the books on concrete. It is devoted exclusively to the methods and costs of concrete construction. It tells what an engineer or contractor needs in estimating the cost and in reducing the cost of concrete work, both plain and reinforced. The various designs of forms and centers and the layout of plant for mixing, conveying and placing concrete, receive the most complete treatment ever given to these important subjects.

The book should be purchased by every contractor and by every concrete foreman and superintendent, for it is the best "correspondence school" on practical concrete construction that has ever appeared in print. Cloth, 6x9 inches, 700 pages, 306 illustrations; price, $5.00 net, postpaid. Sent postpaid on receipt of price by Cement and Engineering News, 1117 Schiller Bldg., Chicago.

ROAD CULVERTS.

One bad, or ill-made culvert can spoil all the pleasure of riding over miles of good roads. They are also responsible for most of the accidents and deaths met with on the roads by automobile users. When one is traveling a good road and the going is smooth and pleasant he is likely to forget that in the middle there may be a culvert, perhaps not over five feet wide, made of planks that have sunk below the common level; or a plank is torn up or banks of mud deposited on one side or the other that give the vehicle a hard jolt and if the driver is not carefully holding his wheel and attending to his business as driver, he may be suddenly thrown to one side and ditched. Many lives have been lost through bad culverts on good roads; they are a snare for even the best drivers of motor propelled vehicles. The first thing to consider in building good roads is to provide for good culverts, that the most dangerous parts of roads on account of grades may be at least as safe, if not safer, than the main part of the road. Concrete is the only proper material with which to build strong, enduring culverts. Booklets and information for building concrete culverts will be mailed, free of charge, on request to Merillat Culvert Core Company, 640 Main street, Winfield, Iowa.

CHAS. WARNER LIME COMPANY.

The Charles Warner Company, of Wilmington, Del., which operates plants at Cedar Hollow and Whiteland, Pa., the securities of which are soon to be listed on the Philadelphia Stock Exchange, is the successor of an organization which, under the same family management, has been in business since 1774. The present company was incorporated in 1885.

The concern has no bonded indebtedness, and there is outstanding $844,800 first preferred stock, of an authorized issue of $1,250,000; $443,800 second preferred, of an authorized issue of $750,000, and $1,573,000 common, with $5,000,000 authorized, of which $2,000,000 is held in the treasury to provide for the conversion of the preferred. Last year the gross sales of the company were $2,479,219, an increase of $132,867 over 1910. Net earnings were $141,962, or about 21 per cent on the outstanding first preferred stock.

The company's business consists in manufacturing and selling lime, cement, plaster and sand, and its sales organization covers the territory from Maine to Virginia, east of the Allegheny Mountains. It moves an average of 3,000 tons of material a day. It employs 800 to 1,000 persons.

The principal plants are in Chester and Montgomery Counties—the Cedar Hollow and Whiteland plants, near Malvern, Pa.; the McCoy plant, near Bridgeport, and the Keystone plant, near Plymouth Meeting. They are situated in the magnesium lime belt, and the company controls practically all the known available deposits of magnesium limestone in this territory, selling approximately 60 per cent of the lime products consumed in this district.

The directors are Alfred D. Warner, Charles Warner, A. D. Warner, Jr., W. W. Laird, C. C. Bye and Irving Warner, of Wilmington; William West, of Philadelphia, and S. C. Rowland, J. S. Wilson, Jr., and Samuel Piper, of Baltimore.

GYPSUM PRODUCTION LARGE.

The quantity of gypsum mined in 1911 was 2,323,970 short tons, valued at $6,462,035, as stated by E. F. Burchard, in an advance chapter on "Gypsum" from "Mineral Resources for 1911," published by the United States Geological Survey. This was a slight decrease from the figures for 1910—1.05 per cent in production and 0.94 per cent in value—but while the industry was not especially active certain changes, such as the replacement of old mills by a smaller number of larger modern mills and the establishment of mixing plants in commercial centers, should result, according to Mr. Burchard, in the saving of freight charges on finished plasters and enable the products to be sold to the consumer at low rates.

Gypsum was produced in 17 States and in Alaska from 78 mills. The imports for 1911 were considerably reduced.

A copy of the report may be obtained free on application to the Director of the Geological Survey, Washington, D. C.

Post Supported Upon Its Ends with a Barrel of Water Suspended From Its Center.

LACKAWANNA MAKES THOUSANDS OF FENCE POSTS.

Up in the mountains near Boonton, N. J., the Delaware, Lackawanna & Western Railway Company has located a plant for the manufacture of reinforced concrete fence posts for its lines, to take the place of the fast-falling wooden posts now in use. Between 15,000 and 20,000 concrete posts were manufactured at this plant in 1911. Over 300 line post moulds and twenty anchor post moulds are used at this plant, which is located at one of the several rock quarries of this company.

The posts are made from the small sizes of the crushed rock, ½-inch and smaller being used. The mix is made in the proportion of one part cement to two parts of fine rock, and four parts coarse rock, making posts which are as white as snow and with very smooth surfaces. The manufacture of posts here serves the purpose of utilizing the small stone formerly considered quarry waste.

To facilitate moulding, individual U-shaped sheet steel moulds are grouped upon a supporting frame, which holds them up from the ground about two feet, the supports being springs. When the moulds are filled and the posts reinforced, the concrete is settled by vibrating the moulds longitudinally upon the supporting springs. The filled moulds are then transferred to level ground. After taking the initial set in from 6 to 24 hours, the posts are rolled half over. The posts, which have round backs and flat faces, are left with their flat faces down on the ground to season for several days, being kept at an even moisture. After this they are piled on end to economize space, as shown in the illustration. Posts, after being made, should season for at least sixty days before they are set in fences.

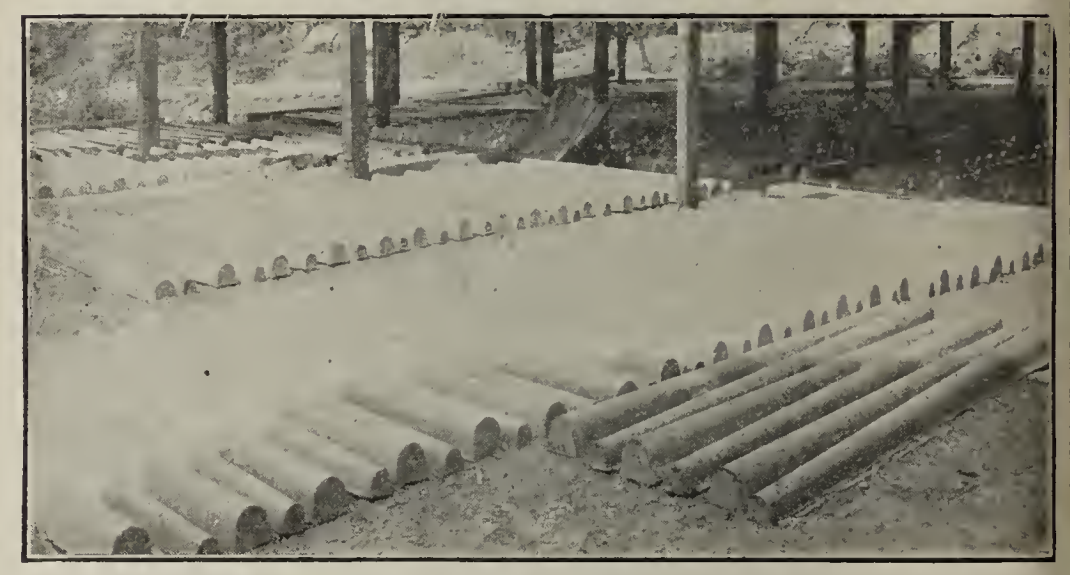
In transporting these posts, about 500 line posts and twenty-five to thirty anchor posts are placed in a car, and reasonable care is taken in packing them, shavings or sawdust being used.

The quantity of posts already made at this plant should be convincing evidence of the satisfaction which they are giving this large manufacturer. They are fast being adopted by the leading railway companies of the country.

The D. & A. Post Mold Company is the manufacturer of the equipment used by the D., L. & W. Ry. Company, as well as that of nine other leading railway companies.

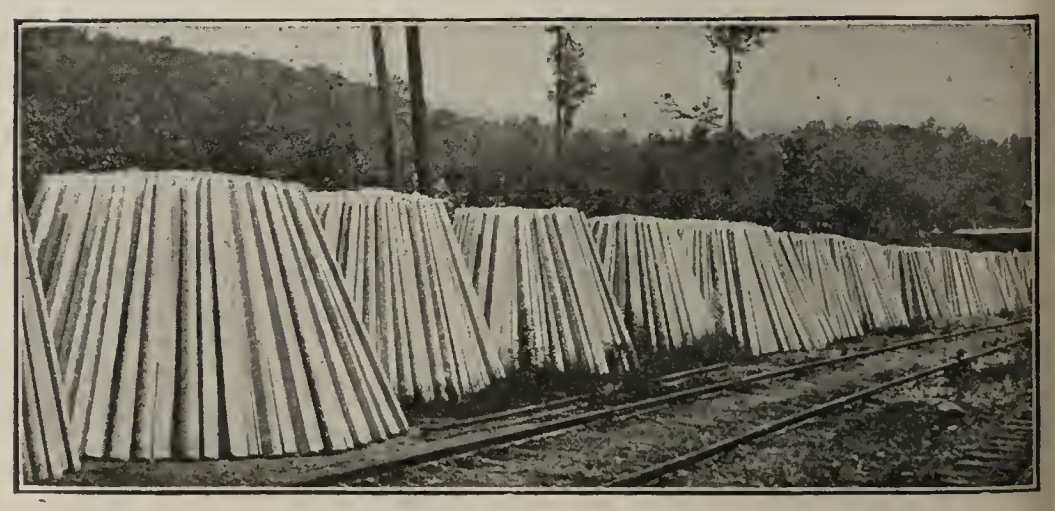
SAND AND GRAVEL NEWS.

The Ashtabula Beach Sand & Gravel Company, located at the harbor just west of the Pennsylvania railroad docks at Ashtabula, Ohio, is shipping from six to eight cars a day. The sand comes from the lake bottom and is drawn by a suction machine together with gravel and water through a pipe and shot into a sieve which separates it from the gravel. A clam shovel is used by the company to take the washed sand from the washing bed and dump it into cars.



Posts Lying Flat Upon the Ground—Seasoning.

Claude E. Negley, of Indianapolis, Ind., has bought out the New White River Sand & Gravel Company and the Fall Creek Sand Company going out of business. They have incorporated for $25,000 under the name of the New White River Sand & Gravel Co. New machinery has been installed and business is reported as first class.



Posts Standing Upon End.

Concrete Piles and Concrete Piling Equipment

By Maxwell M. Upson.

Concrete Piling is a child of cheap cement. It was not until the late '90s (when the cost of cement began to decline) that the inventive minds of America and Europe turned their attention to the substitution of concrete for wood in this long used method of foundation construction.

It may not be too rash to predict that historians will refer to the period through which we are now passing as the "Cement Era." The marked improvement and economy in the manufacture of hydraulic or Portland cement, together with our present knowledge of how to combine it with steel, has made it an economical substitute for almost all types of permanent building construction. Conforming with the history of all widely adopted structural improvements, low cost, or marked advantages resulting in an eventful economy, must be attained before Yankee ingenuity will give itself full swing.

It is probable that as yet we have not more than passed within the gates of the field of usefulness of reinforced concrete. Although rapid strides have been made in the understanding of its theories of design, there is yet much to learn about its adaptability. Furthermore, there is a mental impedence or prejudice against the new or unprecedented, which takes years of experience and education to entirely remove. It is interesting in this particular to observe that, although Europeans (I speak now, particularly, of French, English, German, and Italian Engineers) are more conservative than Americans in most engineering subjects, they have, nevertheless, shown themselves more enthusiastic in adopting, and more versatile in applying, reinforced concrete. While French and English railroads are building long-span bridges of built-up reinforced concrete trusses, certain large railroad corporations in this country have not even given recognition to reinforced concrete, or used monolithic concrete for other than heavy retaining walls and buttresses. Almost the same statement may be made concerning the use of reinforced concrete in wharf and bulkhead construction. Wharves in England, France, and Germany are largely constructed of reinforced concrete, while in this country the number of important structures of this character may be counted on the fingers of one's hands.

Concerning the use of concrete as a substitute for other materials, an interesting experience, recently observed, relates to the design and construction of a balustrade or railing for a Pleasure Pier. This pier was designed for reinforced concrete piles, capped with beam and slab construction; also of reinforced concrete. Naturally, the cost was somewhat in excess of a timber structure. On that account the owners specified that the railing should be of the cheapest possible design of galvanized iron pipe. It was found on careful comparison that an ornamental balustrade, made of concrete and steel, could be substituted for this pipe railing at a slightly less cost, and it was, therefore, adopted. This would seem to indicate that such decisions are often influenced by precedent rather than by actual facts.

Another interesting example, of large magnitude, is the substitution of a reinforced concrete bin, used in charging blast furnaces, for the standard steel hoppers which have been used for the last twenty-five years. In talking to the President of a large steel corporation, the writer suggested such a substitution on account of cost of maintenance and for the reason that the coke often ignites, thereby causing material damage in warping the plates and structural members. It was also suggested that the change might result in economy. After careful designs had been made for both steel and concrete it was found that the ratio of saving was approximately $66,000 against $100,000 per bin, i. e., a saving of 33 1-3 per cent, with a better structure and a lower maintenance.

Let us now consider the subject of concrete piling. There are two schools of concrete piling. The European or premolded reinforced concrete pile and the American or molded-in-place concrete pile. The theory of the European is that concrete should be treated simply as a substitute for wood, and that it should be pre-molded and reinforced so that it will withstand the handling and driving necessary to place it. The theory of the American is that the structure which is subjected to driving should be of steel or of some equally permanent and substantial material, to form a hole for the reception of the plastic concrete.

It does not seem necessary to treat at any length of the reinforced pre-molded type of pile, as it resolves itself merely into a problem of substituting reinforced concrete for wood or steel, and does not involve special equipment or special processes. The problem resulting from this type which has required the most ingenuity to solve, is the design of a cap or cushion that will protect the concrete from fracture during the process of driving. This is usually effected by placing hemp, sawdust, or some like substance in direct contact with the concrete, to distribute the effect of the blow, thereby avoiding fracture through concentration of the impact on a small area. For this purpose one inventor has devised an air cushion, which is said to be satisfactory. One notable disadvantage in the use of heavy cushions of this character is that it practically precludes determining the carrying capacity of piles through observation of their penetration during the final driving.

The pre-molded type of pile, however, has a wide field, particularly in water work or foundation construction in which the pile projects above the ground and is consequently subjected to lateral strains.

The molded-in-place type of pile, which is essentially a foundation or weight-carrying pile, may be divided into two classes:

1. The pile which is formed by (a) driving collapsible steel mandrel encased in a sheet-steel shell; (b) withdrawing the mandrel, after sufficient penetration has been secured, leaving the sheet-steel shell in the ground to serve as a mold or form, and (c) filling this with plastic concrete. This is known as the "Raymond System."

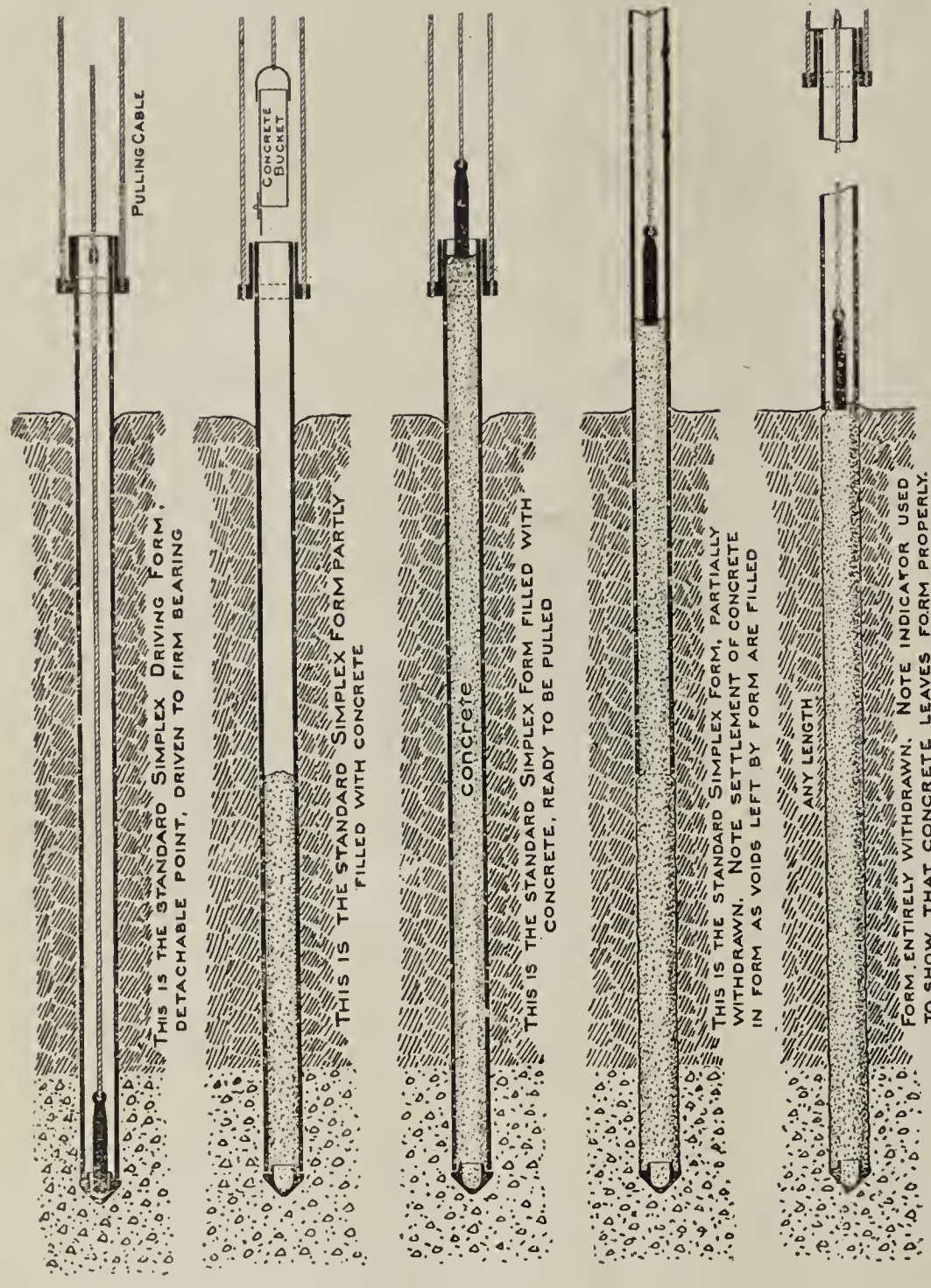


Fig. 3. "Simplex" System of Concrete Piling. Detachable Point.

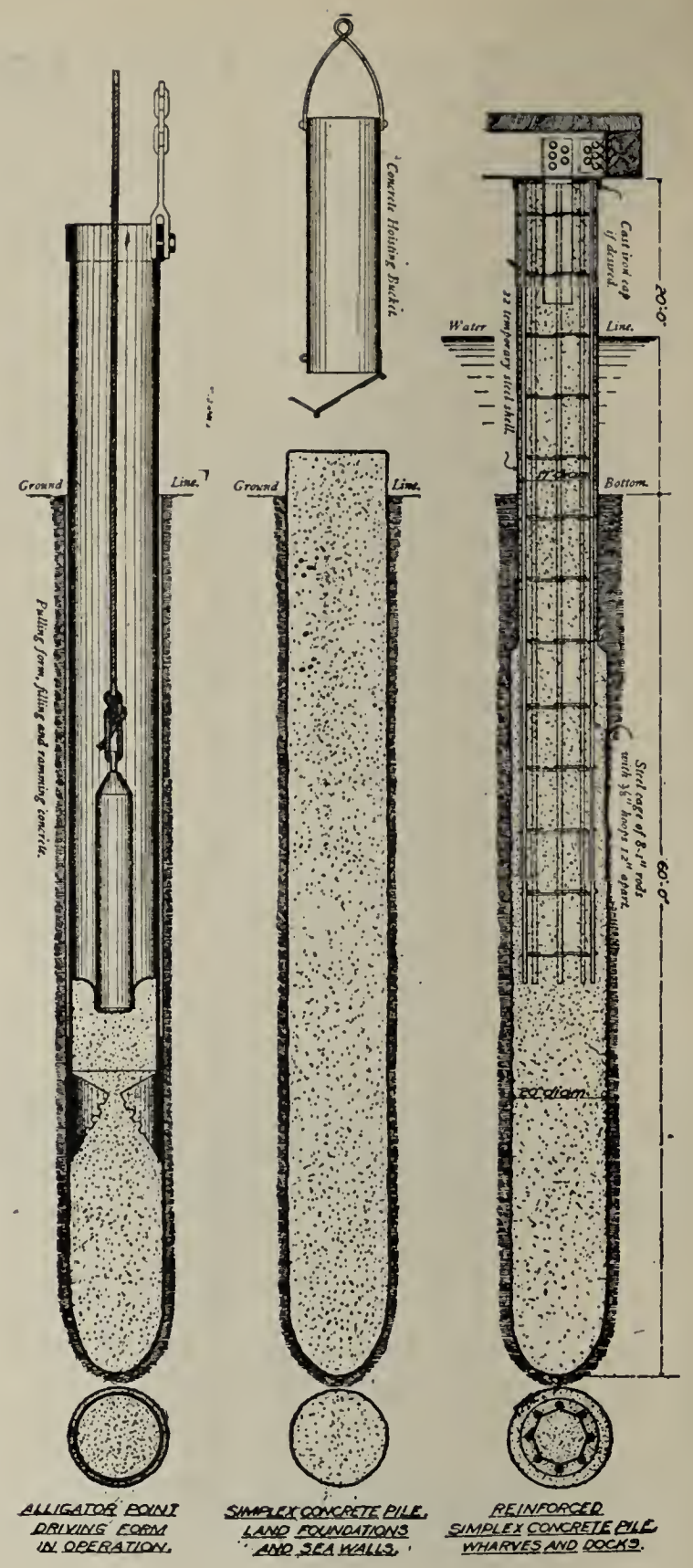


Fig. 4. "Simplex" System of Concrete Piling. "Alligator" Point.

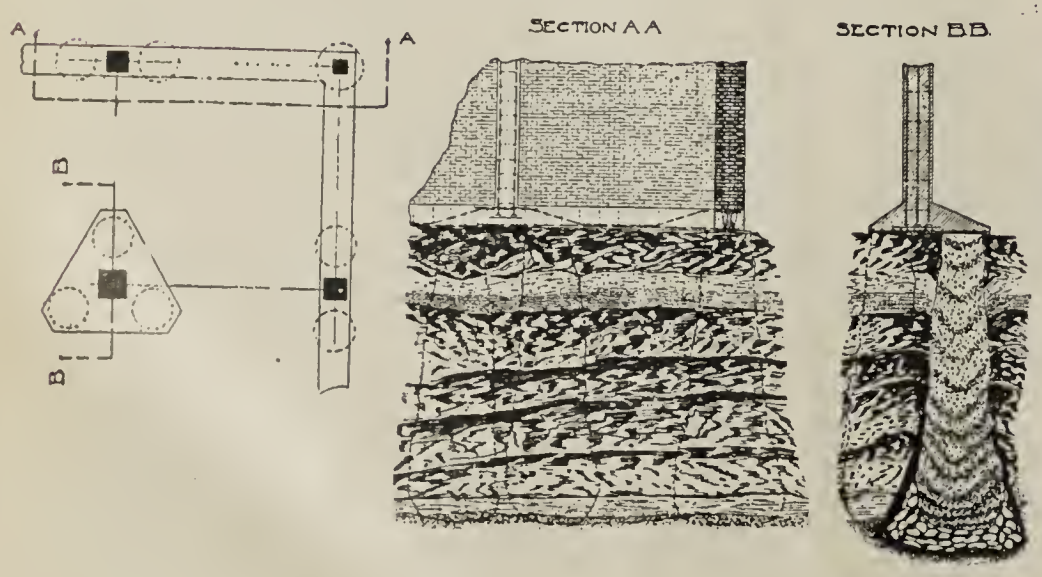


Fig. 8. Arrangement of "Compressol" Concrete Piles in Foundations.

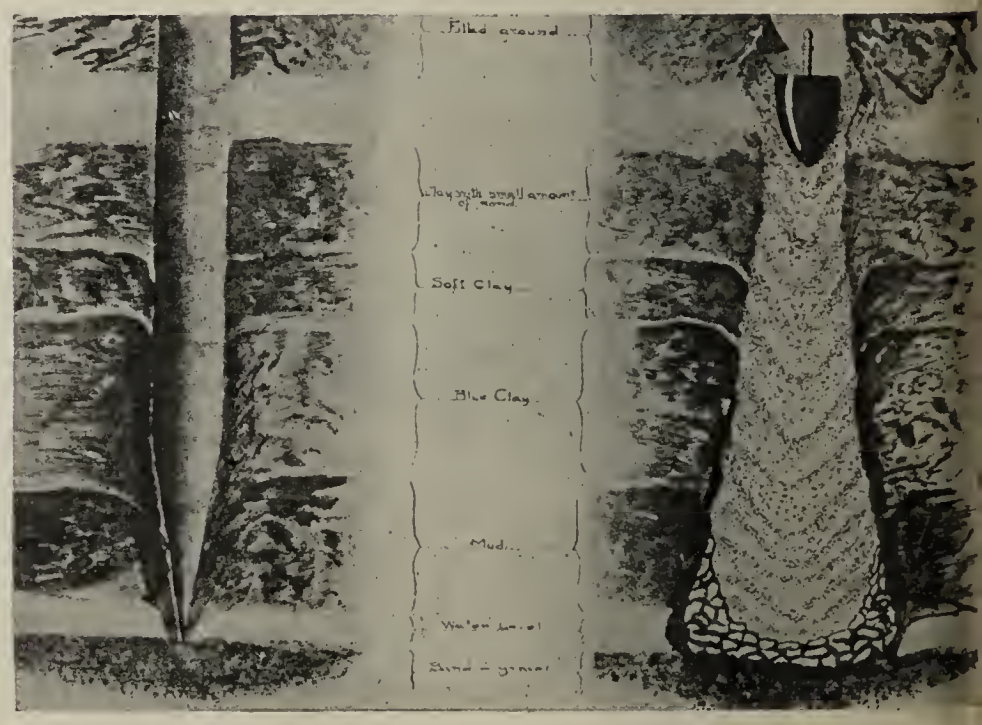


Fig. 7. "Compressol" System of Concrete Piling.

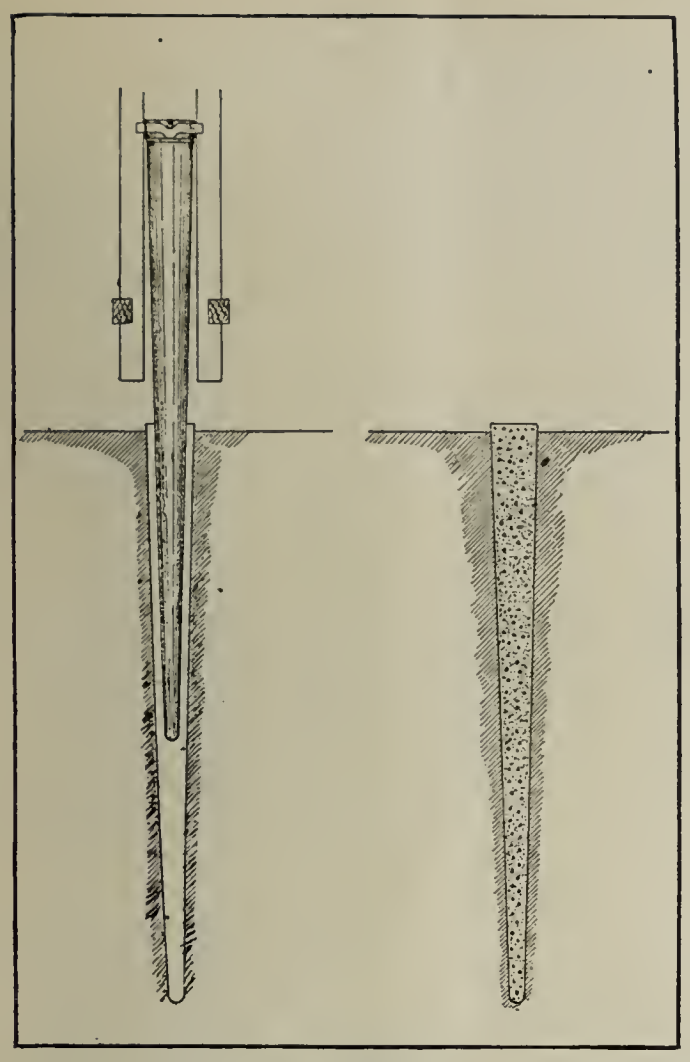


Fig. 1. "Raymond" Pile Core Collapsed and Partly Withdrawn from Shell. Completed "Raymond" Pile Without Reinforcement.

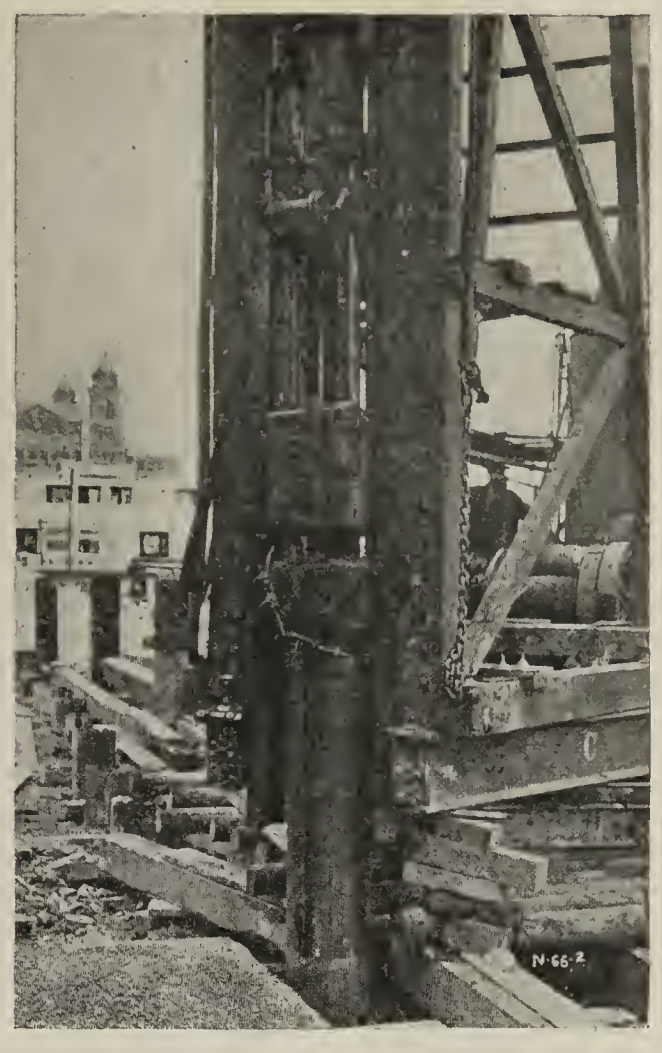


Fig. 2. Shell of "Raymond" Pile Driven to Refusal and Core About to Be Withdrawn.

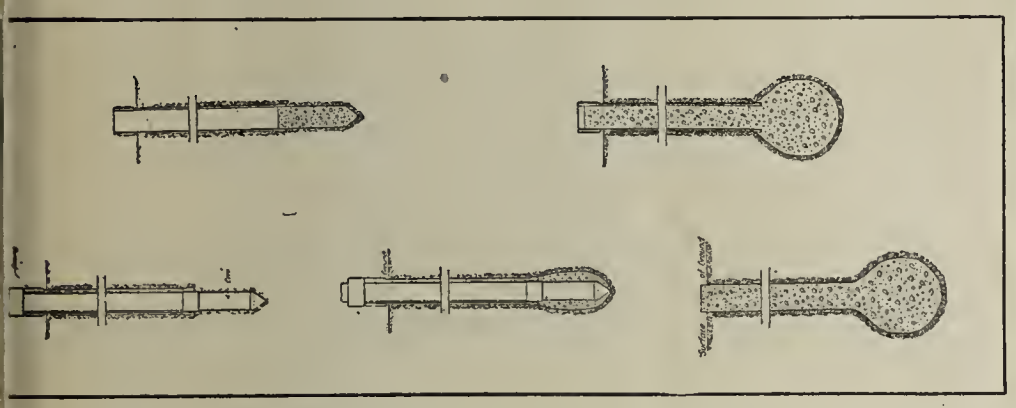


Fig. 5. Various Steps in the Formation of a "Pedestal" Pile.

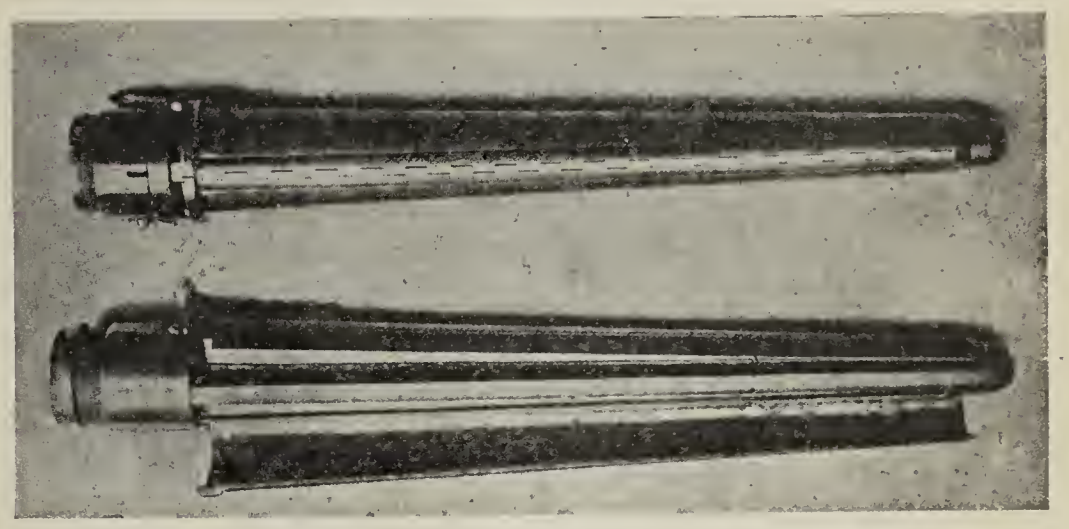


Fig. 6. Tapered Collapsible Form of the "Bilyeu" System.

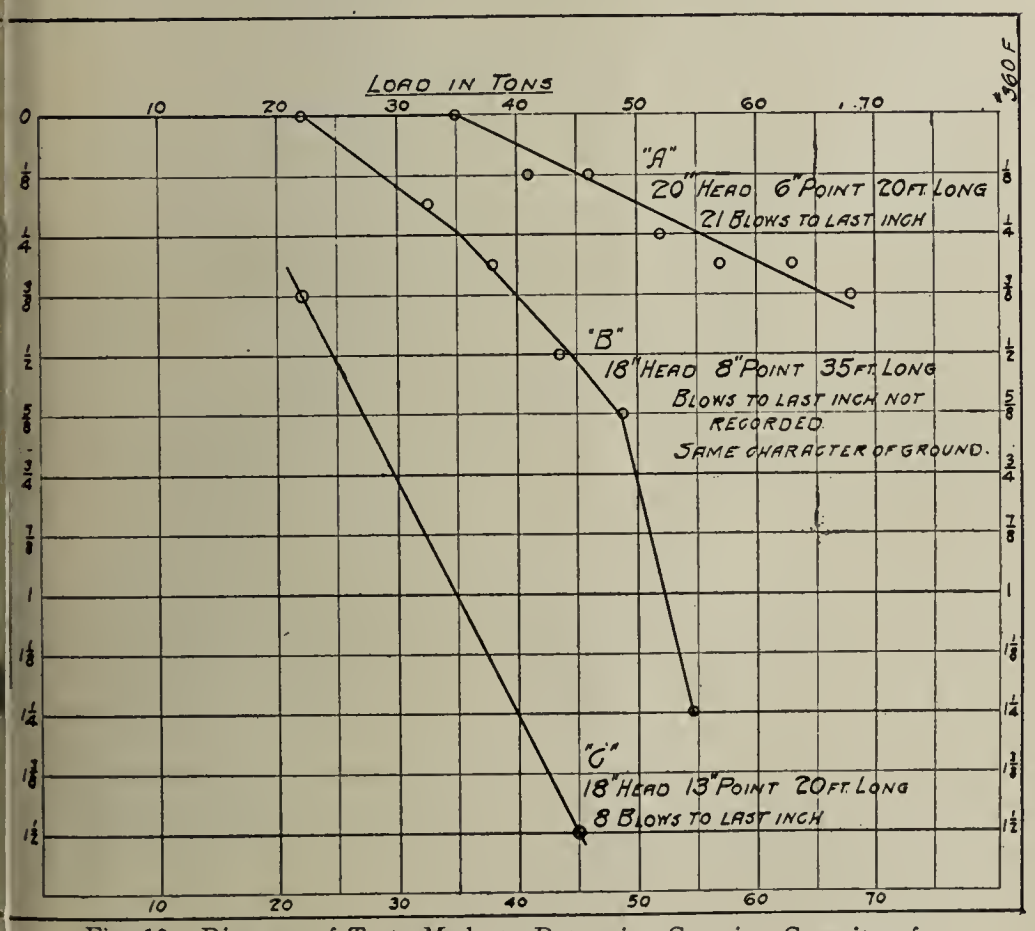


Fig. 10. Diagram of Tests Made to Determine Carrying Capacity of Tapered Piles.

Fig. 9.

2. The pile which is formed by (a) driving a pipe having a cap or protective point, (b) filling the pipe, after sufficient penetration has been secured, and (c) withdrawing the pipe in a manner that will allow the concrete to fill the hole which is left by the withdrawal. This is known as the "Simplex System."

All types of made-in-place piling are based on these two principles.

The Raymond System was the first to be developed and patented in this country. The inventor, Alfred A. Raymond, was a bridge builder and a practical pile-driving man. While engaged in building new work and repairing bridges in Kansas and Nebraska for the Union Pacific and Burlington Railroads during the late '90s, he was impressed with the short life of timber piles used in the construction of trestles. It was in an attempt to secure a sub-structure permanency equivalent to that of masonry superstructure that he devised the Raymond System of concrete piling. The first piles of this type used were driven by Mr. Raymond in the foundation of a Chicago apartment house in 1901. This work caused considerable comment in the engineering world, but it was the general opinion that the field for concrete piling was exceedingly limited and that the business would, therefore, never develop into one of great magnitude. On that account it was some years before Mr. Raymond was able to enlist sufficient capital to adequately promote his ideas.

In 1903, on account of the inability of Mr. Raymond to bid on the foundations for the Connecticut Apartment House, in Washington, owned by the late John Hay, local Washington contractors devised a means of placing concrete piles, which later resulted in what is known as the "Simplex System." Just who was the real inventor is a much mooted question. Interference suits in the United States Patent Office have been under adjudication for the past six or eight years. It is now understood that the courts have awarded the invention to Mr. Richard J. Beal, although Mr. Frank Shuman, who is President of the Simplex Concrete Pile Company, had heretofore been known as the inventor.

In order to illustrate the two systems more in detail, drawings outlining the principles of each are shown. Fig. 1 represents the Raymond System. It will be noted that the collapsible mandrel has been removed from the steel-lined hole. The shell serves the double purpose of preventing the admixture of water or liquid material with the concrete, and of maintaining the shape and size of the core so that the hole can be carefully inspected before the concrete is placed. This is better illustrated by a photographic reproduction of the actual apparatus shown in Fig. 2.

It should be observed that the cores or collapsible mandrels are built with a substantial taper. Mr. Raymond found in his wooden pile work that there seemed to be a marked advantage in the carrying capacity of the pile which had the greater taper. On that account he designed his first cores with a taper materially in excess of anything that may be found in the natural growth of timber. It is interesting to know that this observation has been demonstrated correct, both theoretically and practically, to a degree not appreciated at the time of its adoption. A discussion of this will follow later.

The shell is made of sheet steel of a thickness depending on the elasticity and crushing tendency of the earth. The sections are approximately 8 feet long, telescoping into each other from 9 to 18 inches. On the end of the core or mandrel is placed a boot made of pressed steel. This is of heavier material and is designed to withstand the cutting effect of rock and other obstructions which are encountered in driving. The core is expanded and dressed with the steel shell and boot, then it is dropped into place and driven by means of a steam hammer. When the desired penetration is secured the core is collapsed and withdrawn; the shell is then inspected, to see that a perfect hole has been secured, and is afterwards filled with concrete.

Fig. 3 represents the general principles of the Simplex System. A pipe, closed at its lower end by a cap or point of slightly larger diameter, is driven into the ground until sufficient resistance is obtained; the interior is then either partially or entirely filled with concrete and the pipe immediately withdrawn, so that the plastic concrete will fill the opening formed in driving. Another method of attaining the same end, illustrated by Fig. 4, makes use of an "alligator" point, instead of the metal cap or point previously shown. The method is practically the same, except that the pipe is raised slightly, prior to filling the hole with concrete, and a heavy weight is dropped into the interior to force the "alligator" jaws open, so that concrete may pass to the hole beyond.

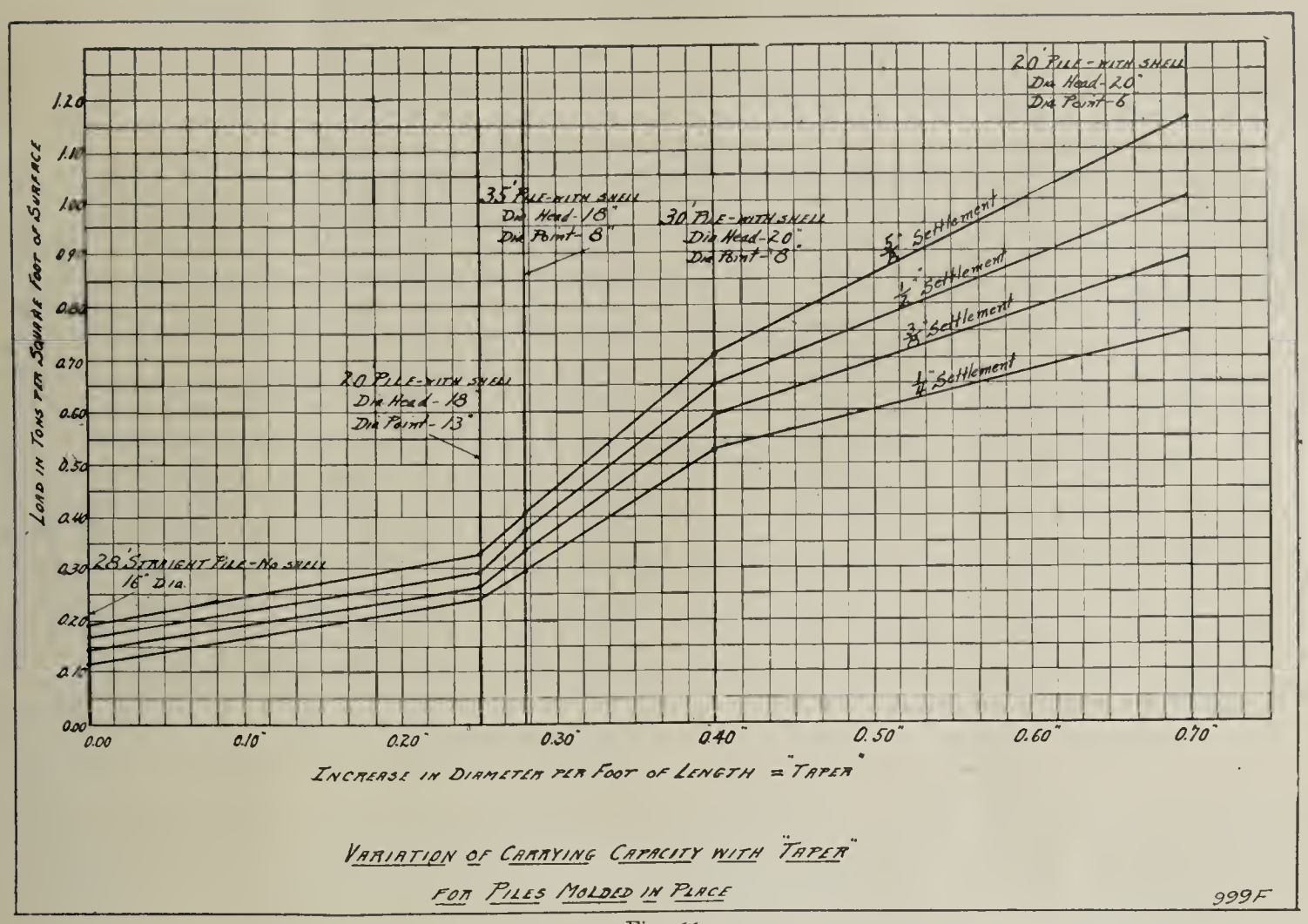
Two other methods of accomplishing practically the same end have been devised by other inventors. One of these, known as the "Abbott" or "Pedestal" Pile, was invented by Mr. Huntley Abbott. This consists of driving a pipe or casing having an interior core which projects several feet below its end. The theory of this pile is that penetration is secured to a hardpan or substantial stratum, upon which rests the point of the core. The enlargement at the base of the pile is formed by ramming the concrete into the opening left by the removal of projecting core before the pipe itself is pulled up. The method of filling and withdrawing the pipe, after the base has been formed, is similar to that of the Simplex System. Fig. 5 illustrates the various steps in its formation.

Fig. 6 shows what is known as the "Bilyeu" patent, in which a tapered collapsible hollow pipe is driven into the ground. Concrete is then injected through the center while the pipe is slightly collapsed, for the purpose of reducing the friction of the adjacent soil against the pipe. This method has been used but little and is fraught with many difficulties that have caused engineers to hesitate to adopt it. Some of these difficulties will be discussed later.

The only made-in-place pile devised by Europeans is shown in Figs. 7 and 8. It is known as the "Compressol" System. Only one foundation of this type has been constructed in this country. Briefly, the system consists in dropping from some distance above the ground a heavy cast-iron or steel weight of plumb bob shape until a hole is formed, supposedly to a substantial underlying stratum. When this stratum is reached another heavy weight with an enlarged base is used in the same hole. This widens out the base preparatory to the reception of large stones and the eventual filling with concrete of a weak mixture.

It was not until concrete piling had been used for several years that engineers began to appreciate its real economies. It is a long recognized principle that timber foundation piles are permanent only when cut off below permanent ground water level. On that account it is necessary to carry the masonry foundation down to such a level. This involves deep excavations, expensive sheeting, shoring and pumping, and a costly and heavy masonry sub-structure from the top of the piling to the superstructure.

With concrete piling the water level may be entirely ignored, thereby permitting pile foundations to begin



Variation of Carrying Capacity with "Taper"
For Piles Molded in Place

999F

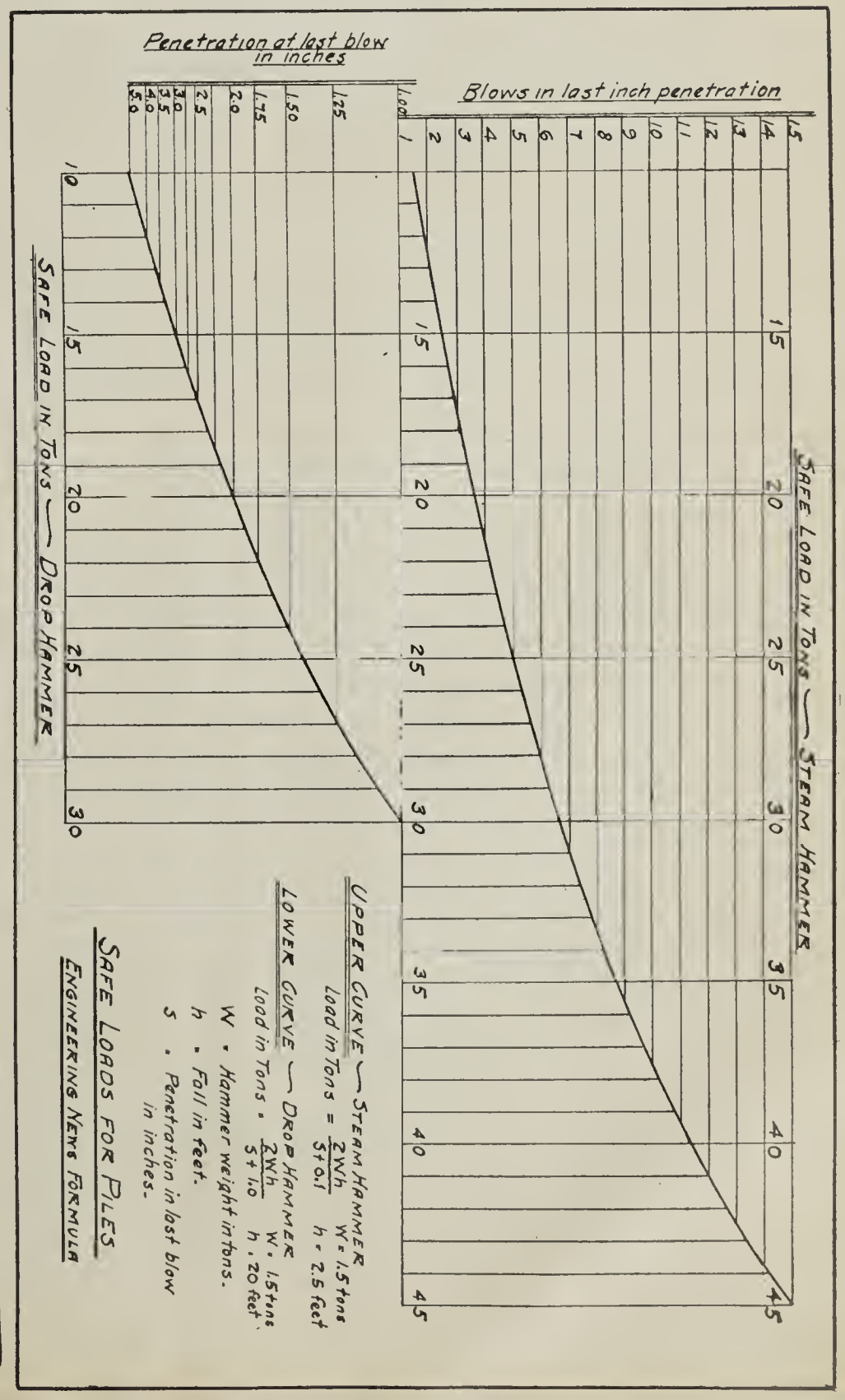
Fig. 11.

Michigan Central Railroad
— Pile Tests —

Name	No.	Driven	Name	No	Driven
Raymond	1	14'-10"	Chenoweth	7	22'-3"
Raymond	2	26'-6"	Chenoweth	9	27'-6"
Raymond	3	28'-0"	Chenoweth	10	32'-0"
McArthur	14	23'-9"	Simplex	22	29'-0"
McArthur	17	13'-6"	Simplex	24	18'-9"
		Wood Pile —	24'-6"		

No. N.Y. 969 F

Fig. 12. Diagram of Tests Made to Determine Carrying Capacity of Various Types of Concrete Piling.



Upper Curve — Steam Hammer
Load in Tons = $\frac{2Wh}{S+0.1}$ W = 1.5 tons h = 2.5 feet

Lower Curve — Drop Hammer
Load in Tons = $\frac{2Wh}{S+1.0}$ W = 1.5 tons h = 20 feet

W = Hammer weight in tons.
h = Fall in feet.
S = Penetration in last blow in inches.

Safe Loads for Piles
Engineering News Formula

Fig. 13.

at any other level. It will no doubt be a surprise to some engineers to learn that not infrequently bids on a complete foundation structure show a saving of as much as 50 per cent in favor of the concrete pile construction as compared with timber.

Fig. 9 illustrates typical designs of timber pile and concrete pile foundation where the floor level is 10 feet above water line. Under normal conditions it is found that there is economy in using concrete piles where this difference in level is more than four or five feet. This, however, is not without exceptions, since the magnitude of the load to be carried has an important bearing on the economy. Fifty thousand dollars was recently saved on the construction of the foundation for a large power station by the use of concrete piles where the cut off was within two feet of low tide.

Another advantage in the use of concrete piles, particularly where heavy loads occur, is in their increased carrying capacity over the timber piles. This is largely due to the size and taper of the former. Furthermore, for the foregoing reasons, concrete piling is, under the same conditions, much shorter than timber piling, so that the comparative cost per linear foot is misleading. It is an established custom among engineers to restrict the loading of timber piles within the range from 12 to 20 tons, while concrete piles may be loaded from 25 to 40 tons with even a greater factor of safety. It will be readily appreciated that the increase in the carrying capacity of the concrete pile in heavily loaded piers makes it possible to reduce materially the size of the piers. As shown in Fig. 9, twenty-five timber piles, each loaded to 15 tons, are required for this pier, while, with the same total load, only eleven concrete piles, loaded to 30 tons, are required. This means decreased excavation, decreased concrete and steel, decreased weight, both of masonry and backfill—all of which have a material effect on the cost.

Comparisons of this kind are sometimes misleading, particularly on account of the assumed cost of unit quantities. The desire of the contractor is to eliminate the quantities that are uncertain. In foundation work, shoring, pumping, and excavating are the most difficult costs to estimate. On that account, and for the reason that it is difficult to approximate the time required to execute the work, the experienced contractor is glad to substitute a construction which reduces or eliminates these uncertainties. Examination of Fig. 9 shows that the size of the footing on concrete piles is smaller than that on the timber piles. This is because each timber pile is carrying about half the load placed on each concrete pile.

For some years engineers were reluctant to allow concrete piling a loading of 30 to 35 tons, and it has been only through a large number of tests and a wide range of experiments that they have been finally convinced that it is good engineering practice.

Another situation which has brought the concrete pile favorable consideration on the part of engineers, is the advent of subways and the lowering of sewers in cities. These have had a material effect on the heretofore permanent water level, resulting in many instances in expensive changes and repairs on structures supported by timber piling. A notable instance of this character is observed in the Criminal Courts Building of New York City, which promises to result in complete rebuilding on account of the damage caused by failure of the piling due to draining of the soil by adjacent subways.

The advantages of the concrete pile are readily appreciated in salt water works where the Teredo and Limnoria exist. This includes practically all the United States Coast, except in harbors where the pollution by sewerage exterminates these forms of animal life. It has been found in many locations that it is utterly impossible to use either creosoted or protected wood in permanent structures, on account of the action of these enemies.

The obvious reason for the increased load lies in the larger area of concrete piles as compared with timber piles, particularly when comparison is made with the timber piling that is available in recent years. The depletion of our forests has made a marked difference, both in the cost and in the quality of the timber supplied for piling purposes. It is now difficult to get piles only as long as 40 feet with a butt that will measure more than 12 inches in diameter. This 12-inch butt compared with the 20-inch butt of a Raymond Pile indicates a ratio of area of about one to two. Since the carrying capacity of the pile depends on the frictional surface and the strength of the pile unit itself, it is obvious that the loading may be increased as these quantities increase. It will be shown later that the volume of a unit of frictional area is greater with concrete than with timber piles. On the other hand, it must be borne in mind that the safe allowable unit value of comparison for concrete is not as high as that of timber. In practice, however, the determination of the loading of a pile depends more often on the carrying capacity of the ground than on the strength of the pile itself. In scores of tests which have come under the observation of the writer there has never been a loading carried to a degree sufficient to show any weakness in the structure of the pile itself, although reports have been made of certain tests where evidence of failure on the part of the concrete has been disclosed. This is explained in several different ways and is too involved and not of sufficient importance to merit further discussion.

It has been stated above that the carrying capacity of the pile depends on the frictional area. This statement means not only the quantity of but also the relationship of this area to the surrounding ground. It is only recently that engineers have been able to prove this positively. To illustrate this point there is shown a diagram (Fig. 10) of tests made by a prominent Boston engineer to demonstrate the increased carrying capacity of a heavily tapered pile as against a slightly tapered or practically straight pile. It will be observed that the abscissæ show the loading in tons, the ordinates, the settlements in inches. These three piles were each driven by a No. 2 Vulcan steam hammer within 15 or 20 feet of each other.

Pile A had a 20-inch head and a 6-inch point, and was 20 feet long.

Pile B had an 18-inch head and 8-inch point, and was 35 feet long.

Pile C had an 18-inch head and 13-inch point, and was 20 feet long.

It will be observed that Pile A with the extreme taper brought up with a resistance of 21 blows to the last inch, requiring about 875 blows for complete driving.

The number of blows required to drive Pile B was not recorded. The final penetration was 8 blows to the last inch. The taper of Pile B approaches that of the ordinary timber piling.

Pile C was driven with 944 blows to a final penetration of 8 blows to the last inch.

The curves record the carrying capacity of the various piles. The Type A pile shows no settlement up to 35 tons and only ⅜ inch at 70 tons. Pile B began to settle at 22 tons and failed at a little over 45 tons. Pile C began to show settlement at once and failed completely under about 25 to 30 tons.

All of these test piles were driven in uniform clay

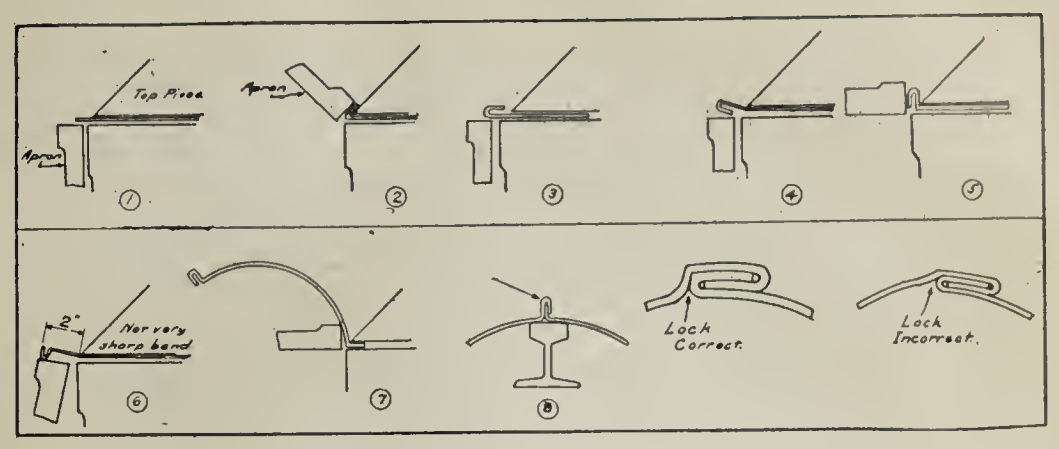
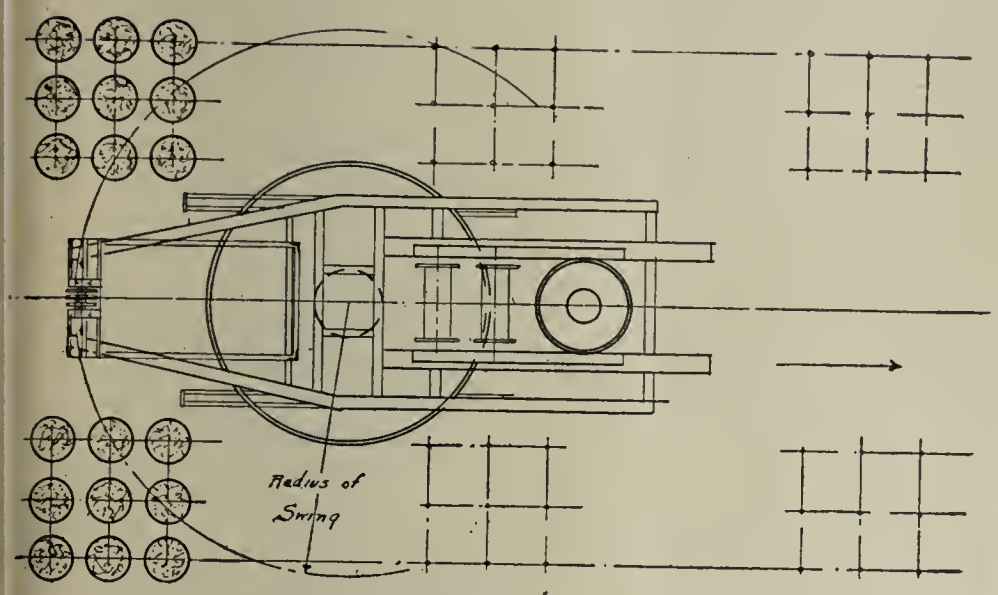


Fig. 15. Method of Forming Seam in "Raymond" Shells.



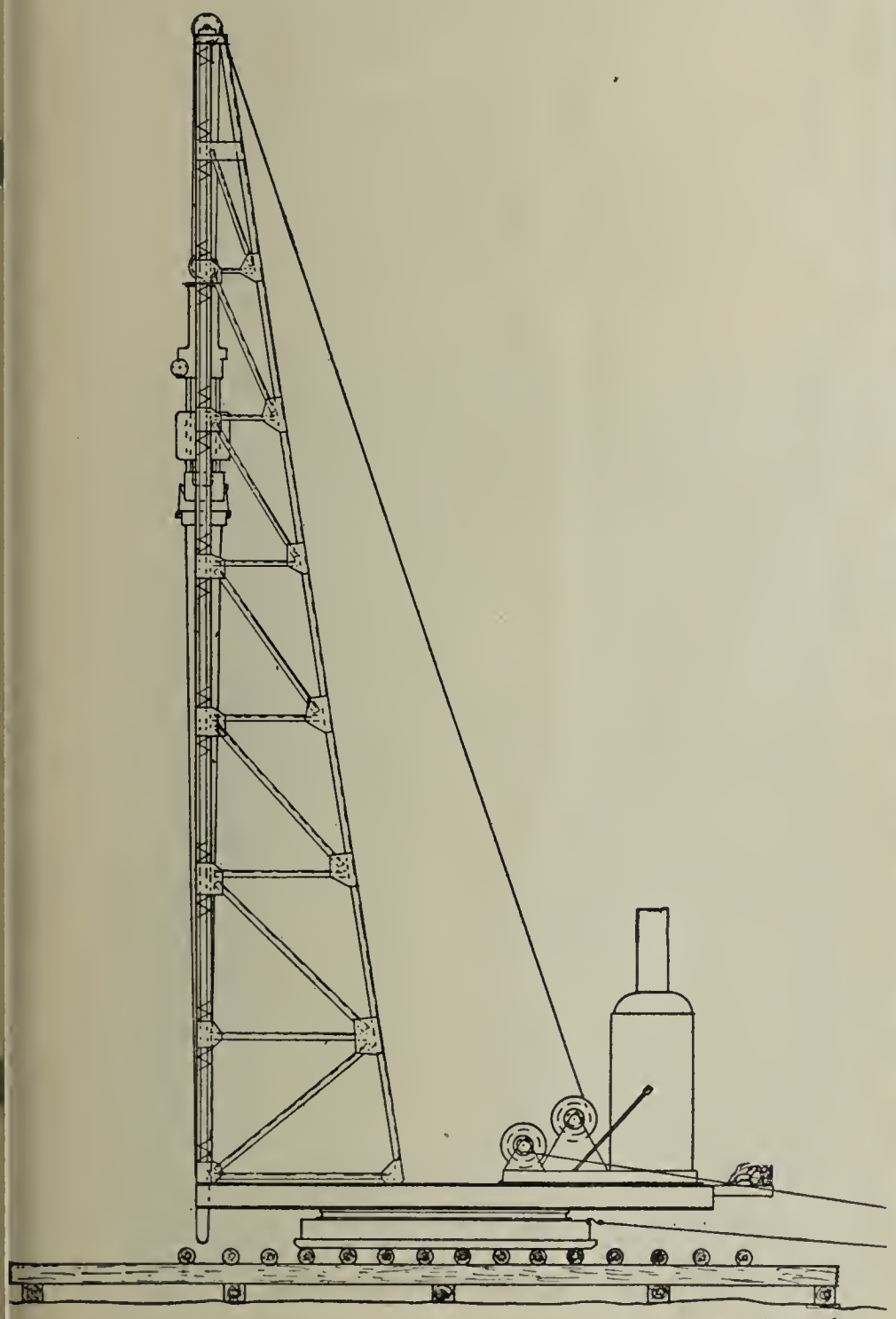


Fig. 14. Plan and Elevation of Standard "Raymond" Pile Driver Mounted on Turntable.

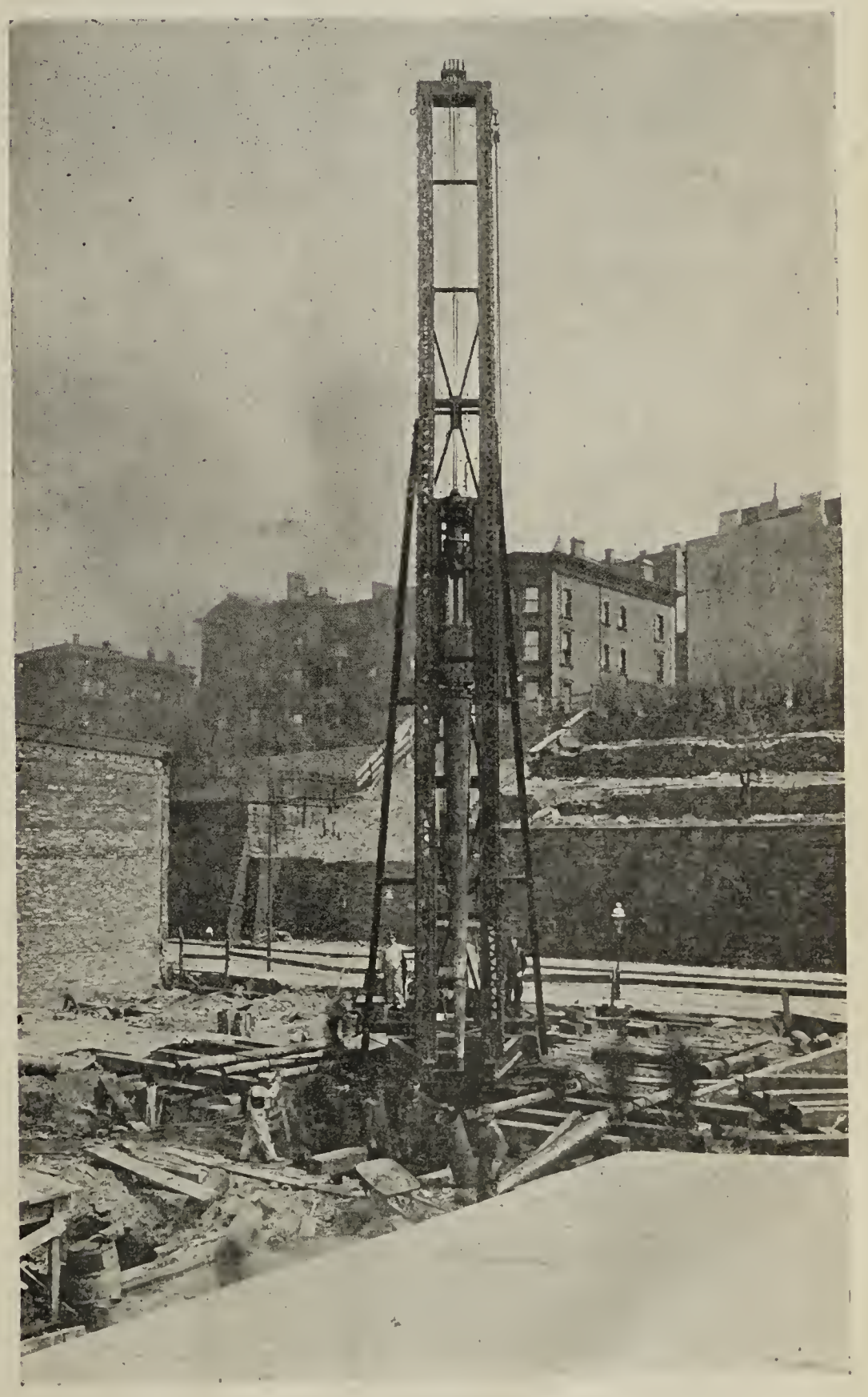


Fig. 16. "Raymond" Pile Driving Apparatus in Operation.

in which no hard-pan or rock was encountered. It is evident from the above that the actual surface of the pile under conditions of this character is not so important as the manner in which this surface is presented to the earth.

In order to illustrate this a curve (Fig. 11) has been prepared demonstrating the relation between the friction per square foot of surface, as shown by the ordinates, and the taper or increases in diameter per foot of length, as shown by the abscissæ. This indicates a very marked increase in the carrying capacity per square foot of surface between the tapers of 0.2 and 0.4 of an inch to the foot, and a very gradual increase from 0.4 to 0.7 of an inch to the foot.

A railroad company recently took the opportunity afforded by the construction of a large work requiring concrete piles, to drive and test four of five different types of concrete piling. A complete report of these tests is not available. The results as far as they can be secured confirm the principles under discussion. All piles were driven in soil of a uniform character, having somewhat less carrying capacity than the soil encountered in the Boston tests. Fig. 12 shows a graphical record of these tests.

Piles Nos. 1, 2 and 3 are of the shell and tapered type. All of these piles show approximately the same carrying capacity per square foot of surface. The cylindrical piles or those of approximately uniform cross-section, as illustrated in Nos. 7, 8 and 9, show a carrying capacity per unit of area of from 30 to 50 per cent. of the tapered pile.

The practical pile man realizes that the type of pile to use depends upon the character of the soil and underlying strata. It is obvious that a pile that carries to rock or hard-pan, through intervening material having no great boring capacity, should be practically straight, so that a large area will be presented to the underlying stratum. It is under these conditions that the pile with the enlarged point would seem to have its field. On the other hand the idea of putting an enlarged point on the end of a pile which does not reach a firm bearing seems in direct variance with the principle of piling, since the compression of the soil caused by enlarging the point necessarily has lifting components as well as horizontal and downward components. This tends to offset the weight of the upper soil thereby vitiating the frictional efficiency of the pile column.

In discussing the advantages of tapered piles as against piles of uniform cross-section, an important commercial principle should receive consideration. The writer finds that in driving in uniform soil, a straight core or one having a very slight taper, can be driven to almost any desired penetration, while a core with extreme taper brings up to practical refusal at comparatively short lengths. Now, it is obvious to the practical engineer that the cost of piling per foot depends very largely on the length of the pile which is driven. That is, there are certain fixed charges which accrue per pile independent of its length. Therefore, it follows that a price of 75 cents a foot for piles 35 to 45 feet long, is much more profitable than a price of $1.00 to $1.25 a foot for piles 15 to 25 feet long. This fact makes it possible for many contractors who use a pile of uniform cross-section to quote a low unit price, basing their information on the knowledge that they will be able to drive piles materially longer than the assumed length.

Consequently, it should be thoroughly understood by prospective users of piles that the cost per lineal foot does not in itself convey any knowledge of the ultimate cost of the work, unless the shape of the pile former is taken into account, or that the penetration is limited by an underlying stratum of rock or hard-pan.

It has been intimated previously that the safe carrying capacity of a pile depends chiefly on the character of the soil into which it is driven. This fact is so true that it is practically impossible to make any empirical rules governing the allowable surface friction and, consequently, the penetration necessary to carry a specific loading. Fortunately, the formula known as the "Engineering News Formula" usually supplies the information necessary to predetermine the safe loading of the pile. It is here shown in Fig. 13.

This formula changes its constant according to the two methods of driving, that is, whether a drop hammer or a steam hammer is used. In the formula:

W equals the weight of the hammer in tons.

H the drop in feet.

S the penetration in inches.

For piling in which the conditions of driving are maintained throughout the filling of the pile, i. e., where the compression of the soil is not released by the removal of the form or the collapsing of a shell, it is found that this formula may very safely be used.

The placing of the piles thus resolves itself into three important operations:

1st—The driving of the pile core or tube to a resistance sufficient to carry the desired load. (This to be checked by the Engineering News Fomula.)

2nd—The maintaining of the hole and the sustaining of the initial pressure between the pile and the surrounding earth.

3rd—The protection of the pile while the concrete is setting, from distortion caused by driving adjacent piles or from the admixture of water, silt, quicksand, etc.

The piles are driven by means of the ordinary steam hammer. This consists of a heavy weight attached to the vertical piston rod of a single acting steam cylinder. The hammer is raised by steam and drops through the action of gravity. Several hammers are now on the market which use steam to increase the impact. As yet, however, the writer has not found them successful in the driving of piles of large mass.

Fig. 14 shows a typical Raymond driving outfit. It has been found that steel leads are stiffer, lighter for the same strength and more durable than those made of wood. On that account they are being adopted now as a standard construction. The leads and engine are on a turn-table which rests on what is termed a "bed-sill." This bed sill travels on rollers laid on timber runways. The driver travels between two lines of piers and swing from side to side to drive the piles. A standard two-drum hoisting engine operates the pile line and raises or lowers the core and hammer. Before driving each pile the core must be dressed with a new shell. These shells are made in 8-foot sections, usually of No. 18 or No. 20 gauge sheet steel. They are made on the field by means of a standard cornice brake and are joined together longitudinally by using a typical tinner's seam (Fig. 15). These sections are pulled on to the core tightly, so that they form a complete covering, each section lapping from 9 to 18 inches over the adjacent section. When the core is completely dressed, a pressed steel boot is placed over the point. The driver may then be swung into position and driving begun.

Fig. 16 shows a photographic reproduction of a standard Raymond driver in operation.

The mechanical problem that for several years taxed the ingenuity of engineers connected with this system, was to provide a shell of sufficient strength to withstand the back pressure of ground of an elastic nature. It was found that while No. 20 gauge metal

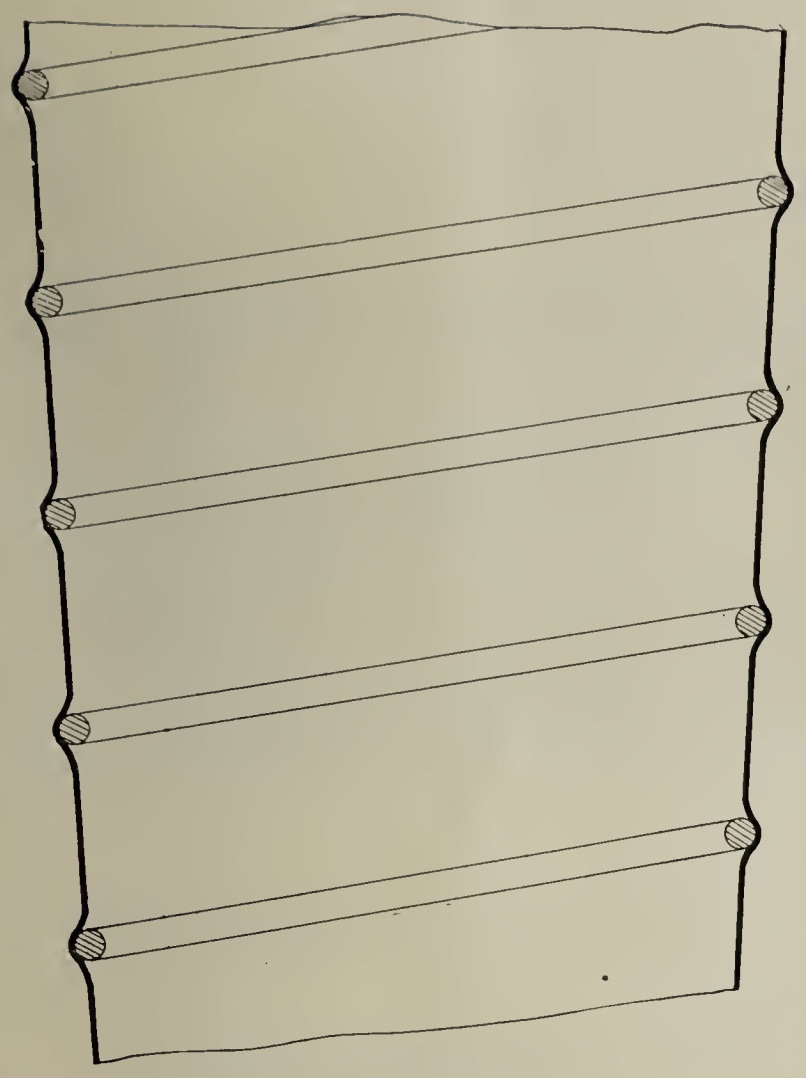


Fig. 17. Arrangement of Reinforcing Wire in "Raymond" Spiral Shell.

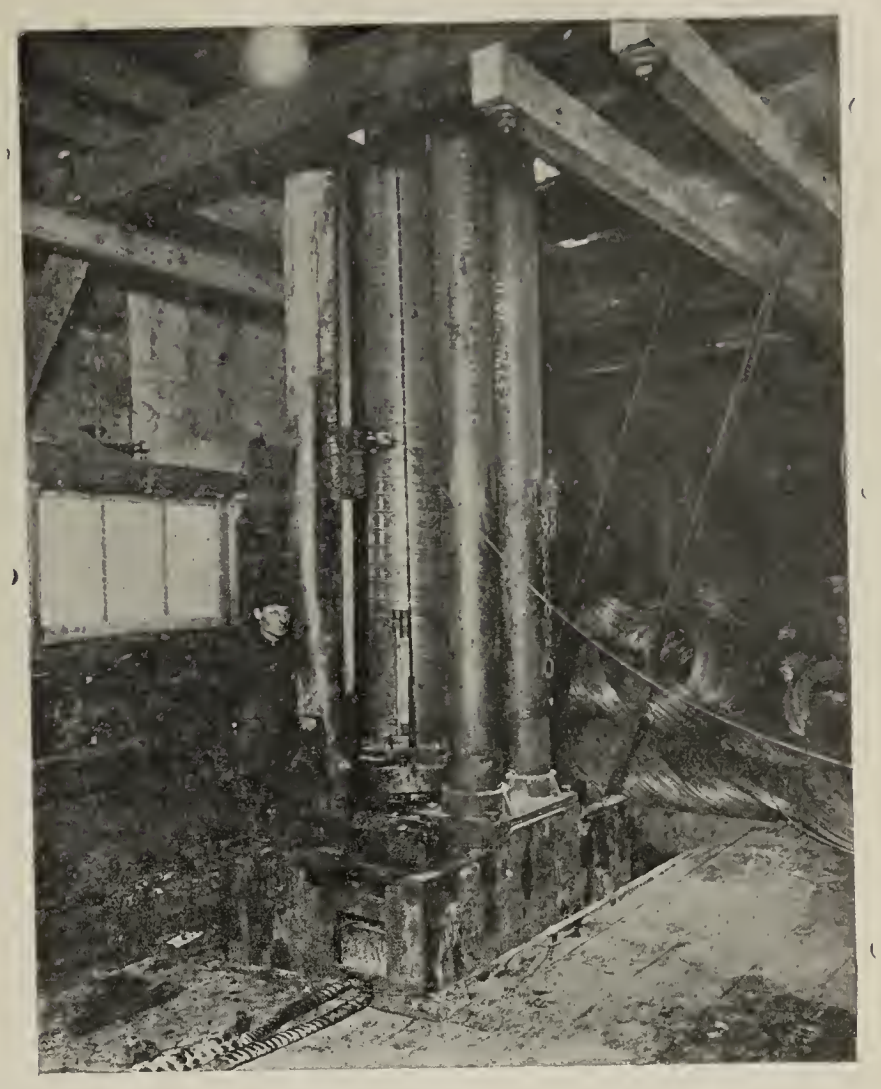


Fig. 18. Winding Wire Reinforcement for "Raymond" Spiral Shell on Collapsible Mandrel.

Fig. 19. Plain Shell Being Slipped Over Reinforcing Wire on Mandrel.

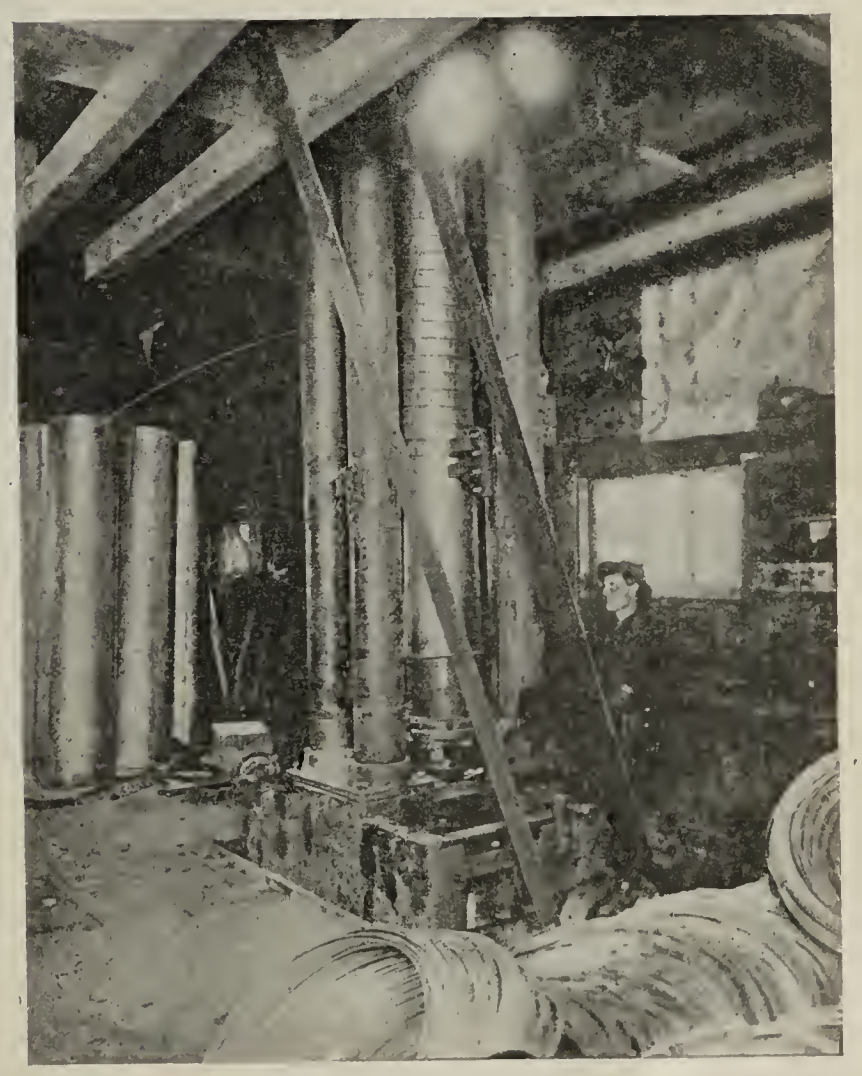


Fig. 20. Machine for Making "Raymond" Spiral Shells. The Scoring Process.

Fig. 21. Swinging Reinforced Concrete Sheet Pile in Place for Driving.

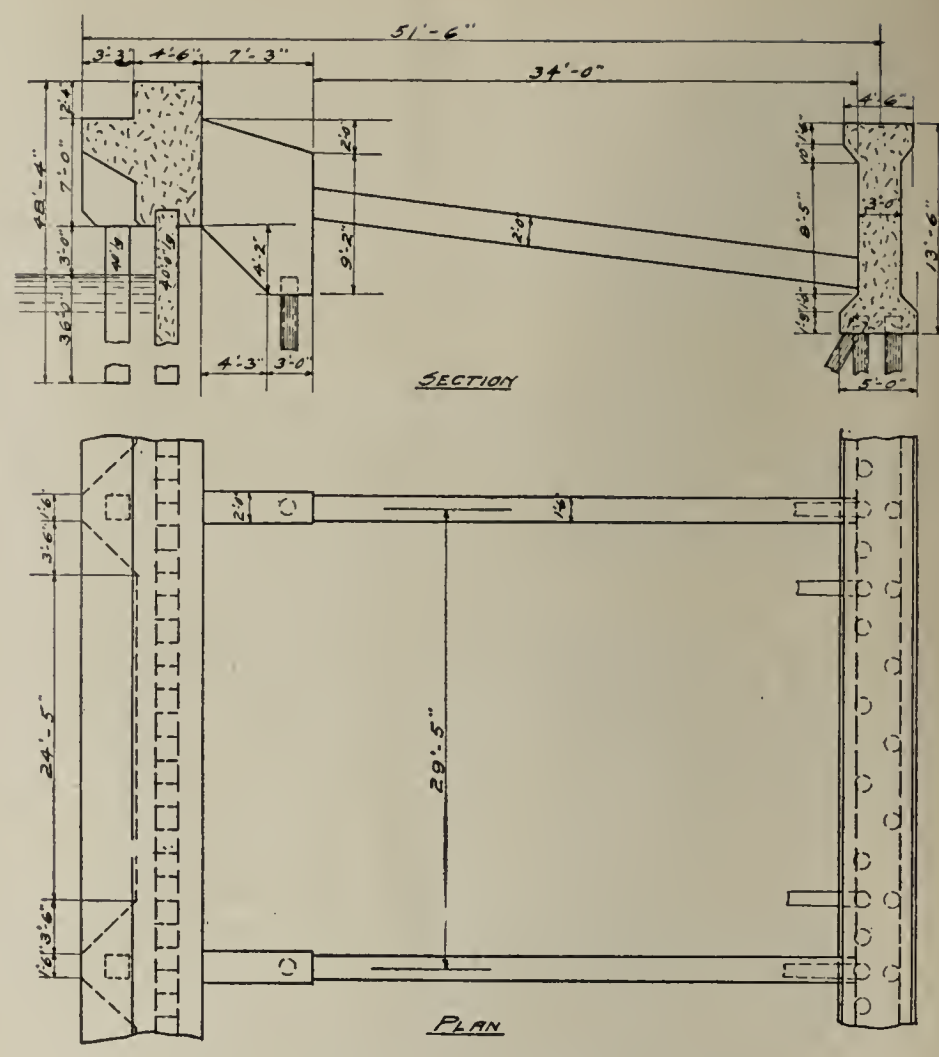


Fig. 22. Details of Dock for Maryland Steel Co.

Fig. 31. Typical Effects of Over-Driving Upon Wood Piling. Piles Exhumed Along the Norfolk & Western Railway, Near Columbus.

Fig. 24. Construction View of Ore Dock for Maryland Steel Co.

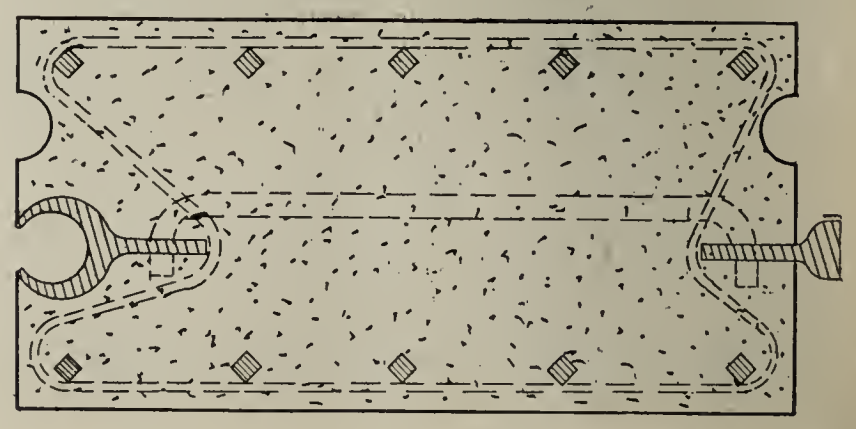


Fig. 30. Cross-Section of Interlocking Reinforced Concrete Sheet-Piling.

Fig. 25. Exterior View of Maryland Steel Co. Dock Under Construction.

Fig. 26. Seasoning Concrete Piles for the Construction of Maryland Steel Co. Dock.

Fig. 29. Outside View of Pier 4 Bulkhead, Baltimore Municipal Docks.

Fig. 23. General View of Concrete Ore Dock Designed and Built by the Raymond Concrete Pile Co., Sparrows Point, Md., for the Maryland Steel Co.

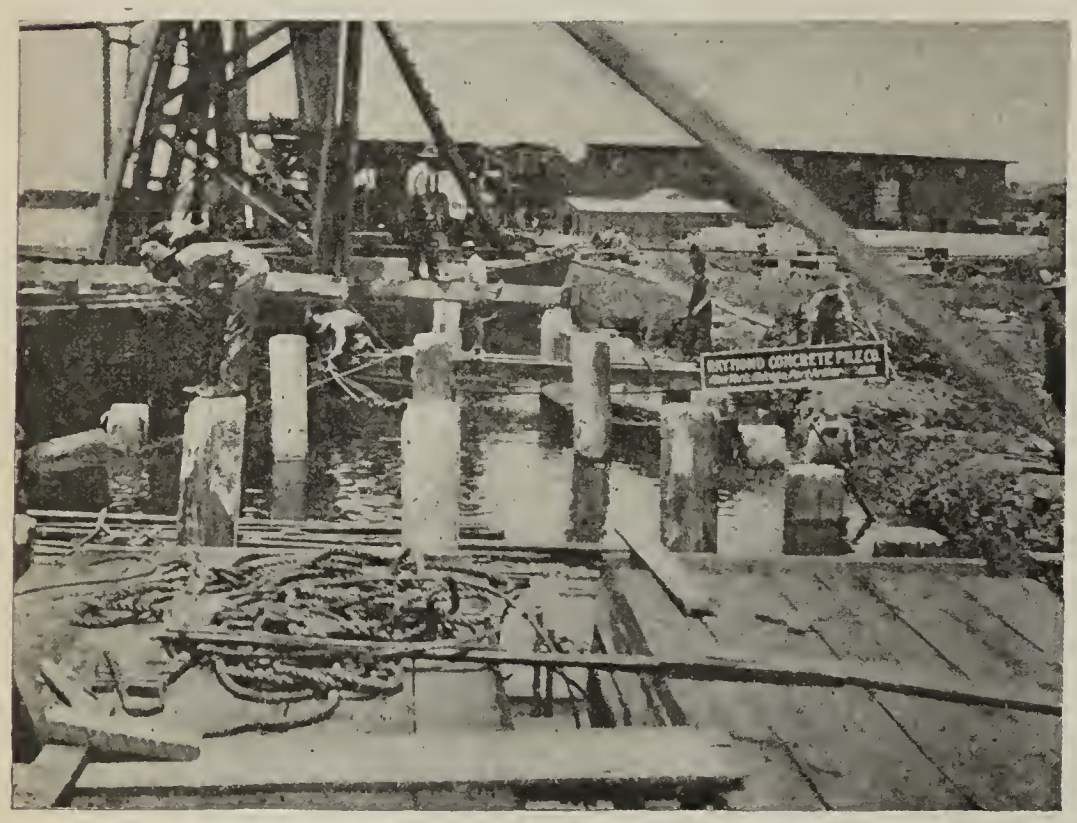


Fig. 28. Initial Work on Concrete Oil Loading Dock at Port Arthur, Tex.

would successfully resist the pressure in certain soils, Nos. 14 and 12 gauge were required in other soils. Furthermore, it seemed impossible to predetermine just what pressure might be encountered. On that account it was difficult to estimate the cost of the shells for any specific contract. A very successful method of overcoming this difficulty is illustrated by the shell shown in cross-section in Fig. 17. This is termed a "spiral shell" and consists of a spiral made of No. 3 wire encased in a No. 24 gauge shell. To manufacture these, special machines have been built, as shown in Figs. 18, 19 and 20. It is found that these shells will resist any back pressure which is encountered in normal ground, and that the material in this form is more efficient in resisting compression. The reasons for this are so obvious to the engineer that an explanation seems unnecessary. Furthermore, the entire length of the finished pile is surrounded by a spiral reinforcement which is undoubtedly the best type of reinforcement for concrete subjected to compression.

Fig. 27. Driving Concrete Sheet-Piling for Maryland Steel Co. Ore Dock.

As stated at the beginning of this paper, the premolded concrete pile has a useful field and Fig. 20 shows a dock construction, for which this type of pile seems particularly well adapted. This is an ore loading wharf designed for the Maryland Steel Company, at Sparrows Point, Maryland. It consists of a reinforced concrete sheet-pile wall upon which is superimposed a wall to take horizontal and vertical loads. See Figs. 22, 23, 2 , 25, 26 and 27.

This wall is steadied by transverse buttresses which, in turn, are tied to a so-called dead-man resting on vertical and battered piles. This dead-man has the double function of holding back the front wall and at the same time affording a support for the rear runway of the crane.

All the sheet-piles used on this wharf were cast before being placed. They are over 40 feet long, and weigh, approximately, 7 tons each. There is 30 feet of water in front of the bulkhead at low tide.

There has been much discussion about the action of salt water on concrete and the technical papers are still giving space to writers on this subject.

Very notable failures of concrete subjected to the action of salt water have made engineers slow to adopt this material in sea water construction. It is found in practically all instances that this deterioration occurs between high and low water, thus indicating that the effect of alternately exposing the concrete to the action of the air and of the water has something to do with the disintegration. Engineers are now coming to the opinion that this deterioration is due to the effect of salt water on the concrete during the time of setting, i. e., that the alternate saturation and oxidation by the air materially impairs the life of the concrete. This is especially noticed in cold countries where frost occurs. One theory is that concrete which is subjected to alternate saturation and drying during the process of setting must necessarily be more or less porous. Due to the excess water, small interstices are formed in the concrete during the high tide. Later the water in these openings freezes on being subjected to the cold atmosphere. The expansion caused by the frost disintegrates the concrete and affords an opportunity for the next succeeding tide to penetrate farther in from the surface. In localities where frost is not a factor, the porous concrete produces the same results by subjecting the entire mass to the action of the chemicals of the

water. It is now the general opinion of engineers who have undertaken to investigate this matter carefully that concrete properly mixed and placed so as to form a dense mass which is then thoroughly cured before being submerged, will withstand permanently the action of the chlorines and other constituents of sea water. It is important that the cement used should be low in magnesia and anhydrous sulphuric acid.

Were it not for a fearless and capable engineer in Baltimore, who, after carefully studying European wharf structures and methods, decided that concrete was best adapted to the harbor improvements in that city, it is probable that the advent of concrete in American wharf construction would have been deferred for another decade. Mr. Oscar F. Lackey, Harbor Engineer of the city of Baltimore, is the pioneer in the use of concrete piling in large harbor improvements. Since he has blazed the way, many are following. Fig. 29 shows a view of one of the Baltimore docks of this character.

A unique method of accomplishing permanent sheet-piling work is shown in Fig. 30. This is known as the reinforced concrete steel interlocking sheet-pile. It was patented by the writer some years ago as a means of making an absolutely tight wall to retain silt or quicksand below the water line. It consists of a concrete pile reinforced to meet the load to which it is subjected. In the sides of each pile are embedded the two members of a light weight steel sheet-piling. These are tied together at certain intervals by steel rods. Their function is to securely lock the pile together until the semi-circular recesses on either side may be freed from mud with a stream of water and filled with cement mortar by means of an ordinary grouting machine. There are many applications for this type of sheet-piling, particularly in bulkhead, for curtain walls underneath dams, or in building caissons to solid material in river or harbor bottoms; it has all the advantages of steel sheet-piling together with the increased later strength and permanency of reinforced concrete.

It has been unfortunate for those who are interested in the advancement of concrete piles, that some of the people engaged in this class of work, following their desire to operate cheaply, have placed piles in soft soil without protecting the concrete from the admixture of water, silt, etc. Furthermore, they have driven piles adjacent to the unprotected green concrete previously placed in the ground, in a manner that has caused the intervening earth to distort and cut these green piles in pieces. Such work has naturally resulted in settlement and grave foundation difficulties, all of which have had a disastrous effect on the adoption of concrete piling by conservative engineers. It must be said without prejudice to any particular type of pile that certain fundamental principles underly the placing of concrete in the ground in a manner to assure satisfactory results and to secure the support of the superimposed load. It is, therefore, important that engineers carefully study the various systems of concrete piling in detail before they are able to determine the type of pile that can safely be used in foundation work.

CEMENT PLANT IMPROVEMENTS.

C. L. Carman, consulting engineer, 919 Insurance Exchange building, Chicago, Ill., informs us that he is preparing plans for the reconstruction of the Raw Material Department of the Chicago Portland Cement Company's plant at Oglesby, Ill. Mr. Carman was formerly chief engineer of the Riverside Portland Cement Company at Riverside, California.

MANGANESE STEEL FOR ECONOMY.

The Edgar Allen American Manganese Steel Company of Chicago, Ill., and New Castle, Del., presents the accompanying illustration as evidence of the remarkable endurance of "Stag" Brand Maganese Steel.

This pinion, together with others of the same make, was used for driving conveying machinery, and was in continual operation for over 25½ months, while the average service given by cut steel pinions under exactly the same conditions, was only three weeks.

That the metal is wonderfully tough is unmistakable. Note that even though worn down very thin the teeth did not break.

While it is not good practice to wear out a pinion to the extent shown, this is an example which is characteristic of the wonderful economy which results from using good manganese steel.

The makers of "Stag" Brand Manganese Steel are turning out and selling many hundred tons of castings per month in the form of gears, pinions and other heavy service equipment, which fact demonstrates the extensive approval and adoption of this metal.

THE MODERN GASOLINE AUTOMOBILE.

Its design, construction, operation, maintenance and repair, by Victor W. Pagé; price $2.50; handsomely bound in cloth; more than 500 specially made illustrations. The most complete, practical and up-to-date work on gasoline automobiles ever published. The last word in automobile literature.

A thoroughly practical, non-technical treatise, written in simple language for those who desire reliable and latest information on all phases of gasoline automobile construction, operation, equipment and repair.

The widely varied experience of a recognized authority gained as driver, repairman and designer of automobiles since the inception of the American motoring industry, is condensed and simplified for easy assimilation. Advice and helpful hints are given by one who knows because of actual mechanical and engineering knowledge of all branches of the automobile business and should be of more value than the guesses and surmises of the theorist.

The author of this book is the originator of simple discussion of technical subjects relating to motor car design. His former works have helped thousands to understand matters usually considered within the province of only the engineer or mechanic. This latest treatise excels all previous efforts and contains more practical information between its covers than any other two works heretofore published. All historical matter has been eliminated, there is no padding or descriptive matter relating to antique mechanisms or obsolete features of design. The illustrations are original and distinctive, and as they are simplified and adapted from engineering drawings they are correct in every detail and proportion. They show actual mechanism used in domestic and foreign automobiles as at present designed, not freak constructions that have no value in practice. Useful to all contractors.

RECORD TO BE PROUD OF.

The five million barrels of Atlas Portland Cement already supplied for the construction of the Panama Canal have been accepted without the rejection of a single barrel. In consequence the United States government, to be perfectly safe, has ordered the Atlas Portland Cement Co. to supply, in addition, all the cement necessary to complete the work in the entire canal zone.

ELECTROLYSIS OF PLAIN CONCRETE.

We have heard considerable of late regarding the possibilities of destruction of concrete through passage of electric currents from embedded steel reinforcement into the surrounding mixture. In a recent paper read before the International Association for Testing Materials, Mr. Cyril De Wyrall, Chief Inspector of the Interborough Rapid Transit Co., of New York City, discusses the possibilities of electrolytic destruction of unreinforced concrete. The following observations are abstracted from his report:

Four years ago an inspection was made of a concrete wall which was erected in 1902. This wall, which carried no load, is below tide level, is 3 ft. thick, and is made of 1:2:4 mixture of cement, sand, and trap rock. It was placed with care and under competent superintendence. The examination showed a disintegration to such an extent that the surface was practically mush. A year later another examination was made; and large sections, from 4 to 6 in. thick, which crumbled in the hands, could be pulled off the face. Last year, still further deterioration was found to be in progress, and a chisel could be driven 12 in. into the wall by hand alone. A voltmeter test showed that current under 11 volts pressure was passing through this structure. It was believed at the time of the second examination that the "failure" was due to the action of salt water alone, and no test was made for stray electrical currents until lately.

This is not an isolated case. There is an exact duplicate in almost every particular, except that the latter structure was erected a year later and different brands of cement were used. In the summer of 1911 the writer made an inspection of some concrete tunnels and bridges erected by three different railroads entering New York. This work has been only recently finished. Each of the railroads had its own cement laboratory, and the different brands of cement used were rigidly tested. The structures are all above tide level, and wet only in spots. Where the concrete is wet, from one to five volts was found, and the concrete is deteriorating, though not so much as in the former instance. Where the concrete is dry, no voltage was found, and the concrete is in excellent shape; this occurs in the same tunnel, the concrete apparently being the same mixture and placed at the same time. It seems to make no difference whether the concrete was placed in cold or warm weather, deterioration goes on just the same, the only difference being between the wet and dry places.

It is a known fact that although wet concrete is an excellent conductor, dry concrete is practically a non-conductor. The combination of electric current and water seems to act as a disintegrating agent on the cement, destroying its cohesion and reducing it to a paste, which when dried can be pulverized with the fingers. This condition demands immediate remedial measures, or serious trouble will undoubtedly ensue.

One efficient means of preventing the damage may be mentioned—waterproofing thoroughly all parts of a concrete structure that is surrounded by earth. Such protection acts in two ways; it keeps the structure dry, and it insulates against electric currents.

HEIDENREICH'S "POCKETBOOK."

The large sale of Heidenreich's Pocketbook for designers of reinforced concrete demonstrates again the fact that the true merit of any book soon becomes generally known. As a labor saver Heidenreich's Pocketbook is directly comparable with the best pocketbooks on structural steel work. Its tables are very complete. The book is leather bound, 374 pages, and its price is $3.00 net, postpaid. Can be supplied by writing Cement & Engineering News, Schiller Bldg., Chicago.

GROWTH OF THE SAND AND GRAVEL INDUSTRY.

Not until the facts are set forth in definite figures does even the experienced sand and gravel man realize the enormous growth—enormous in volume and rapidity—which has been shown by this branch of the building materials industry during the past few years. The U. S. Geological Survey issued recently a bulletin giving the following table showing the tremendous increase in sand and gravel production from 1902 to 1910:

Years.	Quantity, Short Tons.	Value.
1902	1,847,901	$ 1,423,614*
1903	2,110,660	1,831,210*
1904	10,679,728	5,748,009*
1905	23,204,967	11,223,645
1906	32,932,002	12,698,208
1907	41,851,918	14,492,069
1908	37,216,044	13,270,032
1909	59,565,551	18,336,990
1910	69,410,436	21,037,630

*Includes only a very small amount of gravel.

This increase in production is due to the more extensive use of sand and gravel in concrete construction work, largely coincident with the growth of the cement industry in the same period, cement production having increased from 25,274,949 barrels in 1902 to 77,785,141 barrels in 1910.

INTERESTING BOOKLETS.

Robt. W. Hunt & Company, designing and consulting engineers, Chicago and New York, and with offices in many of the principal cities in the United States and in England, Canada, Buenos Ayres and Mexico, are sending out to their clientele and to the trade in general some interesting literature bearing on the subjects of inspection, tests and consultation. The company has also issued some very interesting booklets having to do with the testing of cement, and which contain information of unquestionable value and importance to contractors and others interested in concrete buildings. The subjects treated include the technical features of cement manufacture, and in addition a portion of the booklet is devoted to cement mill engineering and the preparation of plans and specifications for Portland cement mills, including power plants, raw material, machinery, etc., of which the company is in position to furnish a detailed report of the cost of construction, and an estimated cost of cement production.

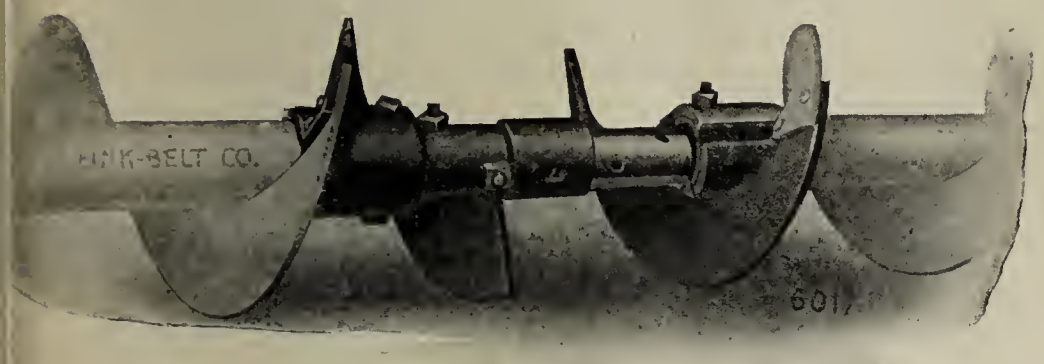
We would suggest to our readers who are interested in this field the advisability of sending for these two booklets, which may be secured by writing to Robt. W. Hunt & Company, 1121 The Rookery, Chicago, or 90 West street, New York City, N. Y.

CONCRETE BLOCK BUILDING.

Consistency requires that a cement company build its own factories and office buildings of concrete. The Universal Portland Cement Co. has done this from the start. They are now building a new Stack House at their South Chicago Plant and several storage and factory buildings at their Buffington Plant of concrete blocks; not so much because of the fact that consistency requires it as the fact that it was tried out and found to be the most satisfactory and economical.

DRUMMOND END-FLIGHT.

In the handling of cement products, ashes, or other abrasive materials, with screw conveyor, delays and expense are caused by the necessity for renewals, because at each journal bearing where the flights are discontinued there is an obstruction offered to the flow of the material along the trough by the journal bearing support or hanger, and the interruption of the conveying spiral at that point. This tends to accumulate material and imposes extra work on the end-flight in pushing it past the bearing into the path of the next section.



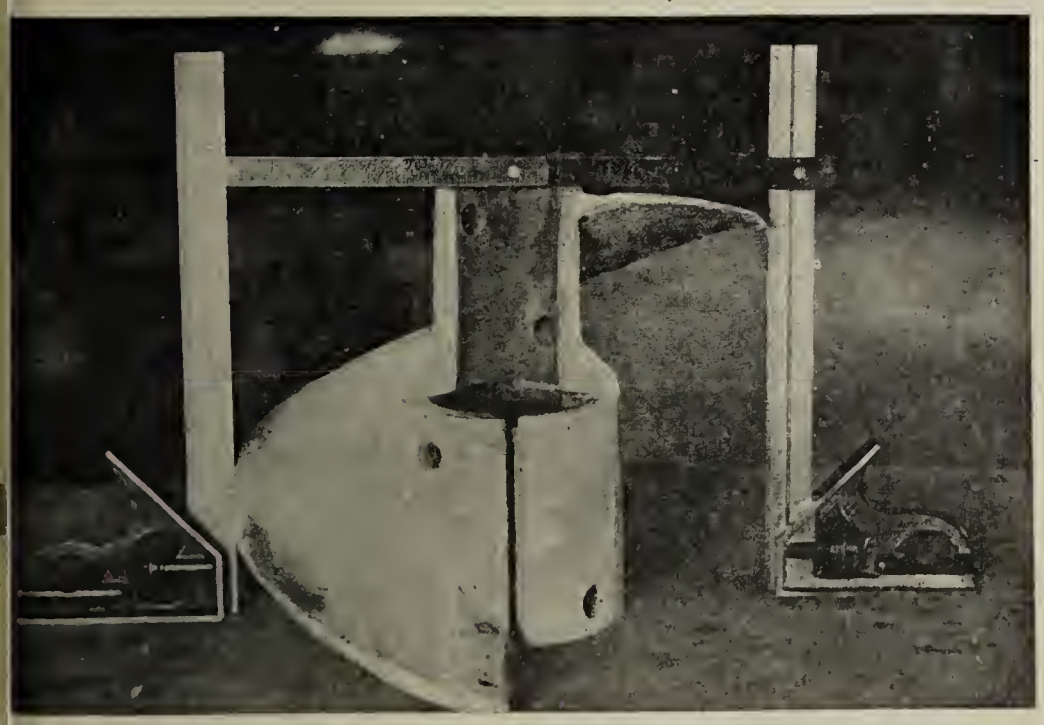
Drummond End-Flights with Coupling Gudgeon, Assembled Complete. The removable cap is omitted from the right end to show detail of arrangement. This clever device is the invention of the late D. D. Drummond, vice-president and general manager of the Chicago Portland Cement Co., and widely known as one of the ablest engineers in the cement industry.

Experience shows that this extra work wears away the end of the delivery flight and its outer edges, until the accumulation extends back farther and farther from the bearing, thus losing efficiency for the conveyor and finally forcing the renewal of the whole section.

The end-flights may be practically worn away, while the rest of the conveyor may show but little wear.

Heretofore when a coupling gudgeon wore down and needed renewal, it required considerable work to remove and replace the old gudgeon and the shut-downs necessary for renewals of conveyor sections and coupling gudgeons, caused serious interruptions.

Mr. Drummond's invention has overcome the difficulties heretofore experienced, by making renewals easy, and furnishing end-flights made of material which is high in wear-resisting properties. The end-flight, generally made of manganese or other hard and tough steel, has a center or hub whose recess is large enough at one side to receive the end of the



A Drummond End-Flight After Six Months of the Same Service Which Wore Out the Five-eighth-inch Steel Flights in Three Weeks.

Three Types of Coupling Gudgeons.

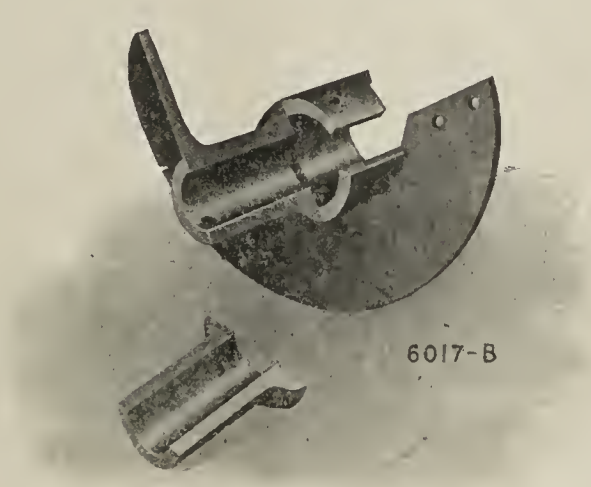
conveyor shaft or pipe, and small enough at the other side to fit the end of the coupling gudgeon. The adjacent gudgeon ends of the two end-flights are provided with removable caps which permit the coupling gudgeon or the end-flights to be taken out or replaced without disturbing the rest of the conveyor. As the end-flights are secured to the gudgeons and to the conveyor shafts or pipes by bolts, it is a simple matter to make renewals when necessary.

Careful measurement shows only ¼″ wear on the outer edges (or ½″ in total diameter). The delivery end of the flight is worn thinner, but is still intact, and the opposite end has full thickness.

The Results of Wear After Three Weeks' Service in Handling Cement Clinker with Five-eighth-inch Standard Reinforced Steel Flights.

The one at the right being a square bar supplied with a round sleeve at the center (in two parts bolted together) to revolve in the hanger bearing. The center gudgeon has the same construction except that the ends are turned round, and the upper half of the split sleeve is shown removed to one side. The gudgeon on the left is a plain round piece of shaft, with bolt holes drilled for attaching the end-flights.

The Link-Belt Co. of Chicago are the sole manufacturers of this clever new device.



Drummond End-Flight with Cap Removed.

EXHIBIT OF THE UNIVERSAL PORTLAND CEMENT CO., AT THE NATIONAL DAIRY SHOW, CHICAGO.

The Universal Portland Cement Co. had a very interesting exhibit at the National Dairy Show in Chicago, October 24th to November 2nd, 1912.

A full siz section of a cow barn floor was built of concrete, a stall set in it and the model finished in perspective painting showing the end of a modern, reinforced, concrete cow barn. There were also on display models of a monolithic silo, watering trough and of a section of the all concrete roads of Wayne County, Mich. Illuminated transparencies, pictures of exceptionally good concrete work about the dairy farm, furnished further attraction.

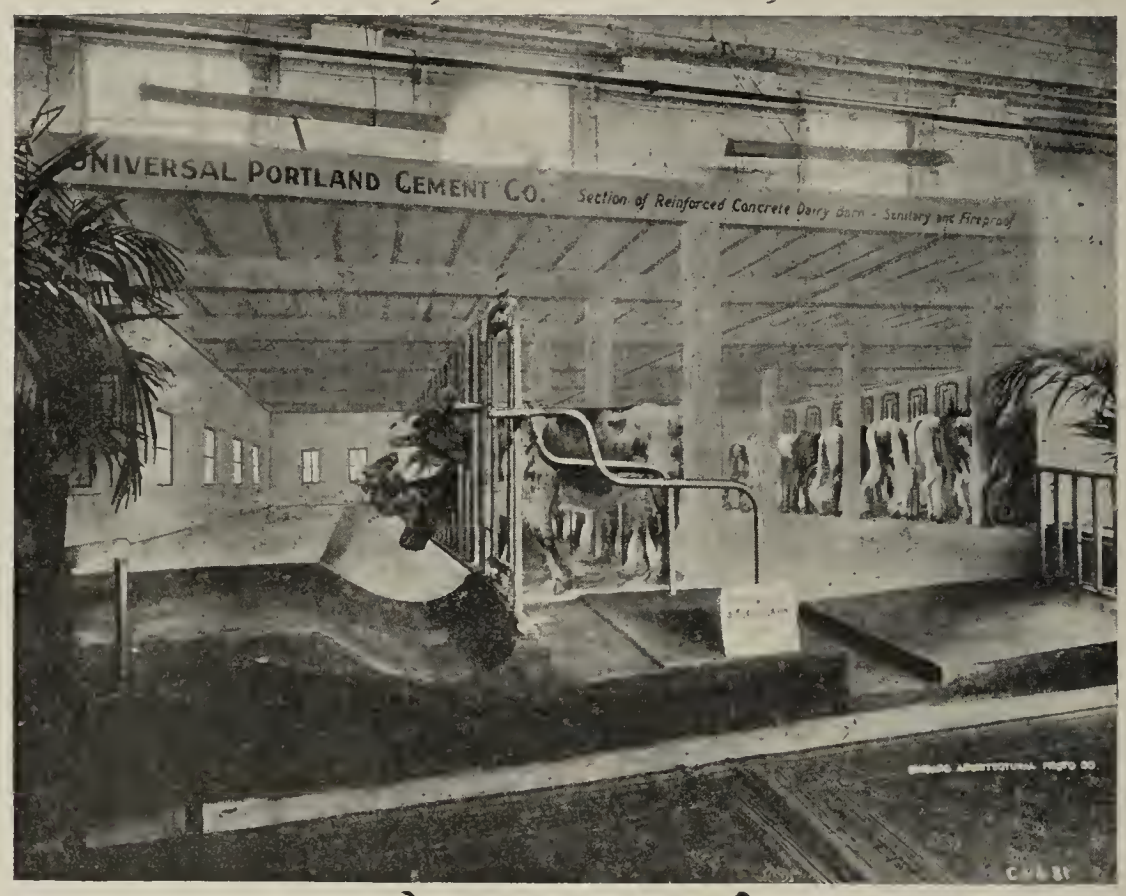
The Company had three men in attendance at all times who were kept busy answering questions and explaining methods of constructing concrete buildings on the farm.

Concrete in the dairying industry is a very important issue. Dairies and barns built of concrete more than meet the Government's requirements for sanitary conditions and are, of course, fireproof, easy to keep clean and practically permanent. The farmer has been easily lead to realize that what has made him a permanent floor will make solid walls and there are now many instances of entire barns, even to the hay floor and roof, being built of concrete.

Much interest was shown in the little model of the concrete road of Wayne County. The farmer who has to drive to the creamery or to the station every morning with his milk can well appreciate the time and expense which will be saved when the old, dirt roads are replaced by modern highways of concrete. Where formerly it took a team of horses, much time and more patience to get to town, especially in rainy weather when the mud roads become almost impassible, by constructing of concrete, a hard, smooth and dustless road is available, which has been made only the more clean by the rain. A small culvert was shown on the model of the road and more than one farmer was heard to remark that "it might not be such a bad plan for So-and-so to build one of those concrete culverts over his creek in place of the timber he's got over there now."

It is the adaptability of concrete to the little things about the farm and dairy which makes it so desirable. It appeals to the farmer's good business sense. He may have a good gravel pit on his farm, probably considerable second hand lumber which could be used for forms, old metal for reinforcing and times when his help is not engaged in the regular farm work. He can then get to work with cement and at a very low cost build posts, watering troughs, cellar steps, cisterns and innumerable other things which will be permanent and clean, will require no looking after and repairing and on the whole prove decidedly an improvement over his old equipment.

The exhibit was attended constantly by large and interested crowds and undoubtedly impressions were made which will result in more concrete building on the dairy farm.



SAND AND GRAVEL NEWS.

J. M. Hammitt of the Rodgers Sand Company of Pittsburgh, Pa., will go to Ambridge, Pa., tomorrow to inspect the eighth steel barge purchased by the company this year.

When the George W. Smyth Lumber Company of Beaumont, Texas, decided about three years ago to add a sand department to its business it was with the idea that it could be carried on with a small force of men, one tug and two or three barges. The business has grown so rapidly, however, that the company has found it necessary to increase the number of barges to a full dozen. Besides having contracts for home consumption of 100,000 cubic yards to be delivered before the first of the year, the concern is making a daily shipment to outside points of from two to three cars.

This increase in the business has compelled the company to abandon the bins at the foot of Pearl street and arrange for more convenient facilities on the docks near the Kirby Lumber Company mill on Brakes Bayou. A large plant will be erected at this point immediately with a capacity of 300 cubic yards a day. The sand, which is of a very fine quality for building and paving purposes, is being taken from the bed of the river about fourteen miles north of the city.

ELECTRIC SPECIAL GROUND GEARS AND PINIONS.

Electric special ground gears and pinions have been developed by the Edgar Allen American Manganese Steel Co. of Chicago to meet the prevailing tendencies towards more rapid service on the electric railways and the consequent use of heavier type of equipment and larger capacity motors and the ever increasing demand for the use of higher grade material to meet these requirements, as well as the increasing necessity for economical maintenance.

No parts of electric railway equipment perform a more important function, nor have been more difficult of satisfactory solution, than the development of suitable gears and pinion, notwithstanding the careful consideration given the subject by manufacturers during recent years. Various processes and treatments have been developed in an effort toward improved material for this purpose.

Profiting from an extensive experience in using a material in a wide variety of conditions where abrasive wear and severe shocks are encountered, and great strength is required, electric special ground gears and pinions have been developed and recently placed on the market.

The rapid growth of recent years and the use of gears for high speed machinery, requires a degree of refinement that was not formerly possible, or even considered necessary. Theoretical design, as well as practical skill have worked together in the betterment of the art of gear making until it has reached a high degree of mechanical accuracy.

Today, mechanical art requires a gear that possesses not only long wearing life and strength, but also is not obnoxious on account of excessive noise in operation. In the process of refinement, cut gears have been heat-treated, or case-hardened, in order to impart to them greater wearing resistance in operation.

However, any heat-treatment changes the molecular construction of the steel to a greater or less extent, and therefore a gear that has been perfected mechanically, will not be perfect after being subjected to a heat-treatment. This change, or heat distortion, is especially objectionable when the heat-treatment takes place after the gear has been machined. These inaccuracies in hardening gears, together with the rough carbonization on the surface of the teeth, have been impossible to overcome.

Thus it is apparent that a material for gears which is naturally hard, giving the greatest wearing resistance and requiring no heat-treatment subsequent to being machined, is very desirable, if indeed it is not a necessity where accurate high-speed gears are required.

The character of the material, nature of the treatment and accuracy of the machining would appear to be especially suitable for the severe service in which this type of equipment operates.

The material used in electric special ground gears and pinions has been specially produced for this purpose, and consists of a special manganese steel of particular chemical characteristics and physical heat-treatment. In this material we have a steel that is most peculiar within itself, and is noted for its density, peculiar hardness, combined with a high degree of toughness, freedom from shrinkage and other defects, ability to resist severe shocks, and especially long-lived where hard and abrasive wear is to be overcome.

The alloy is what is known in the trade as Ferro-Manganese, a compound containing 80 per cent of the element manganese; the ore being mined chiefly in Russia. The introduction of this material in proportions to secure the proper composition, produces a wonderful quality of metal. This when subjected to proper heat-treatment, for the purpose of imparting the high degree of toughness, produces a metal which has proven especially efficient and satisfactory in meeting the severe conditions imposed by the heavy duty of strains and wear on gears and pinions.

It is well to observe that no subsequent heating or retreatment is required, that the metal is of the same density and hardness throughout the section, and consequently is machined by grinding with abrasive wheels, giving a perfectly true and polished surface of exact dimensions. In this condition the material goes into service, thus avoiding any re-heating or hardening processes and consequent distortions, shrinkages or fractures.

The chemical composition of this material has been a most interesting development, originating some twenty odd years ago in Sheffield, England, where Edgar Allen & Company, Limited, were among the first to successfully produce a high-grade product.

During the past sixteen years, in this country, a number of manufacturers have attempted to produce this material in a satisfactory manner, but comparatively few have been successful, owing to the limited knowledge of all the features to be dealt with in connection with each step throughout the processes. A thorough knowledge of the latest requirements in the

art of steel making is essential, as well as adequate facilities of every character, peculiar to this product, are necessary. Unsuccessful attempts along this line have, in some instances, produced unsatisfactory material, and, to some extent, a consequent prejudice against the material. Fortunately, it is now regarded as a distinct branch of the steel maker's art, to be under the careful supervision of specialists of the highest order of experience and training in this line of work.

In the production of this material, the very best steel foundry practices must be employed and strictly adhered to throughout the process. Especial care must be exercised in the design of the patterns to provide proper section, and to take care of increased shrinkages on account of the density of the material.

All steel must be given a most careful heat-treatment in especially designed furnaces, in order that the extreme toughness, for which this steel is noted, may be imparted thereto. This feature constitutes a most important step in the operation of manufacture.

When properly and carefully performed, this heat-treatment leads to most satisfactory and uniform results. With this operation completed, the material is ready to be machine ground and no subsequent reheating, or hardening, is necessary.

The machining is done entirely by grinding, which process has had so much to do with recent practices in accurate machine work. This applies to the internal as well as to the external dimensions, as the gears and pinions are made entirely of the same material.

It has long been the ambition of manufacturers to machine gears of this material, and the best metallurgical skill has been employed to produce a steel for tools that will work it, but without success, even to drill it. Any effort to soften the steel sufficiently to make it machineable has been unsuccessful. It has, therefore, until recently, been necessary to use gears of this material with rough cast teeth, which, while giving exceptionally long wearing life, have been objectionable on account of the amount of back-lash, which makes them particularly noisy at high speed. In grind cutting the teeth, there is very little strain upon the teeth being ground, consequently there is not the tendency to spring or strain, and set up other imperfections and inaccuracies usual where the steel cutter is used on soft carbon steel gears.

It will therefore be appreciated that the inaccuracies in the ordinary gear cutter, due to wear and distortion, are entirely prevented and taken care of in this arrangement. It is possible to machine, or grind cut a gear or pinion much more accurately than previously, and thus correct many defects in teeth that have contributed to rapid wear, excessive noise, and failure or broken teeth.

From the rugged character of the material in resisting shocks, fractures from excessive strains, hardness and wear-resisting qualities, and accurate machine work, it is evident that these gears and pinions will be especially suited to meet the severe service of the heavy type of electric railway equipment.

This, however, applies equally as well to all motors, or machinery using gearing, where strength and long wearing life are essential features in economical maintenance.

While the wearing life of gears and pinions is very difficult to estimate, owing to the great variation in conditions under which they operate, the experience with this material justifies the prediction of a decided increase in life so far as wearing is concerned, and absolute freedom from breakage under service conditions.

The Edgar Allen American Manganese Steel Company is the largest producer of this character of steel in the United States. The equipment of its plants at Chicago Heights, Illinois, and New Castle, Delaware, is entirely modern and up-to-date, and is being continually added to in order to maintain the highest type of efficiency and rank among the best in the steel industry.

The manufacturing organization includes men of international reputation in the manufacture of steels and whose knowledge is of a highly specialized character along the line of the development of Manganese Steel and its correct composition, treatment, and character.

CONCRETE WHEELBARROWS.

A new catalogue has just been issued by the Toledo Wheelbarrow Company, Toledo, Ohio, concerning their new patented contractors' concrete barrows and carts known as the Bull-Frog Brand. It contains very interesting and useful information relative to handling concrete and shows you how you can save money. A copy will be sent free to those interested by mentioning Cement & Engineering News. The Toledo Wheelbarrow Company has agents in Chicago, New York, Atlanta, Baltimore and Philadelphia.

THE IXL ALL SPUR GEAR SPEED REDUCER.

The IXL All Spur Gear Speed Reducers of the Foote Bros. Gear & Machine Co. of Chicago, Ill., are used for many purposes. The most important of which are, for driving belt or bucket conveyors, line shafting, hoists, elevator work of all kinds, or machines requiring greater reduction than can be had from an ordinary line shaft or motor speed. Its greater value is where it takes the place of gearing or belting having a reduction of from 5 to 1 up to 100 to 1 ratio or more.

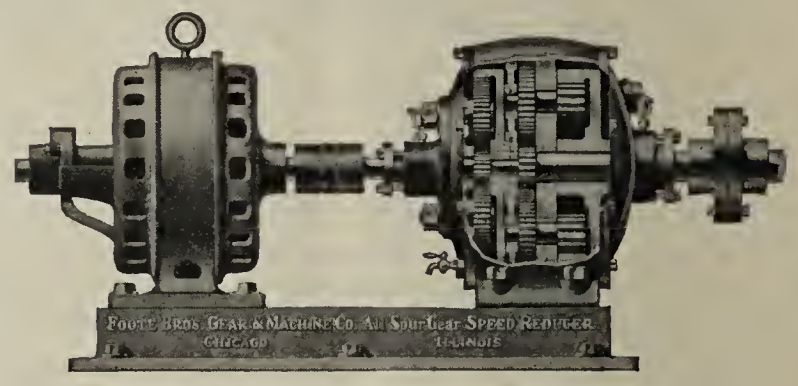
The most important features are that the IXL All Spur Gear Speed Reducer can be used in many places and under conditions where a worm gear reducer cannot be used, that the power and motor shaft are concentric and it eliminates the dangerous working conditions of exposed nest of gear or belting.

The IXL All Spur Gear Speed Reducer is absolutely dustproof, oil tight and free from oil dripping.

All bearings are phosphor bronze bushed throughout, designed for long life and heavy duty.

All high speed pinions and idlers are made of special alloy steel, heat treated and hardened. Internal gears are made of high carbon steel castings.

With each machine is furnished an IXL semi-flexible coupling to compensate for any reasonable error in alignment of the motor and reducer shafts.



The IXL Reducer is constructed on the lines of a motor, the two together create a pleasing appearance.

There is economy in using a high speed motor with this reducer in place of the low speed motor, direct connected to the machinery required to be run, such as line shafting, hoists, elevators, conveyors, etc.

The IXL is designed for many uses, it takes the place of the old method of noisy, dangerous exposed gearing, occupying great space. To the practical mechanic or engineer, a device of this kind will demonstrate its utility over all other forms of gearing and belting now in vogue.

That the IXL All Spur Gear Speed Reducers are a decided success is proven by their general use throughout the United States and Canada, many of the largest manufacturing plants using them in quantities, in some plants as many as one hundred.

A number of these manufacturers are using the IXL Reducer 24 hours per day, continuous duty without overheating or causing the usual annoyances that machinery is subject to under such conditions.

Catalogue No. R of the Foote Bros. Gear & Machine Co. gives further details concerning their machinery.

REASONS WHY BULK CEMENT SHOULD BE USED.

The Universal Portland Cement Co. offers the following views on the subject:

The initial outlay for bulk cement will be 40c per bbl. less than for cement in cloth sacks and 10c less than for cement in paper. Every cloth sack on a job, or in transit to or from a job, whether filled or empty, represents an investment of ten cents. Every paper bag used represents a fixed loss of 2½ cents.

There will be no fuss or argument over sacks received in torn condition. If rain should get into the car, there will only be one or two lumps of set cement to be lifted out; there will be no partially damaged sacks to handle and no lumps of set cement to be pried out of sacks.

No matter how cement is bought, it is bulk cement that goes into the mixer. Therefore, labor employed in emptying sacks, that is, reconverting sacked cement into bulk cement, is wasted labor. So is the labor that is spent in shaking, counting, bundling, shipping and keeping track of empty sacks, for there is no real reason why there should be any sacks on the job.

In computing the total cost of cement used on the job, the various sack losses and expenses must be added to the invoice price of the material—therefore, eliminate this loss and expense and reduce the cost of the cement. If sacks are used some of them must surely be destroyed, through carelessness, wilful abuse and natural wear and tear, and some of them will probably be stolen. All these destroyed and stolen sacks cost money; why not get along without sacks?

There will be no freight to pay on returned sacks. The sack shed can be used for storing something that is really needed on the job—or need not be built at all. The team can be doing something worth while instead of hauling sacks to the depot. The bookkeeper and clerks won't need to be keeping tab on a lot of sacks which run into big money and don't do the job any good. After they have put in part of the time formerly devoted to this kind of work in figuring the profits resulting from the use of bulk cement, they can spend the rest of the time in figuring further ways of cutting costs and increasing profits.

Cement sacks are very attractive to the men. Split open, they make good aprons. If a man is working in mud, a couple of sacks wrapped around his feet will protect his shoes. In rainy weather a sack will keep his shoulders dry. Sacks are handy as tool bags and for carrying nails, rivets, etc. Lots of them are stolen. All these sacks cost the user of the cement 10c each, and, furthermore, if the men are allowed to get into the habit of misappropriating one kind of property they won't stop there. Soon, belting will be cut up for hand shields, tools will be misused and other valuable property made away with.

ELECTROLYTIC ACTION ON UNREINFORCED CONCRETE.

By Cyril de Wyrall, Chief Inspector, Interborough Rapid Transit Company, New York.

About five years ago the writer noticed the effect of electrolysis on column bolts imbedded in concrete piers. It was evident that the concrete surrounding the bolts had become disintegrated, so much so in some cases as to render it almost useless and the effect was greatly intensified where the piers were wet. In view of this, the writer became interested in knowing what would happen to plain concrete if it were wet and had an electric current passing through it which could escape into the earth.

Four years ago an inspection was made of a three-foot concrete wall, erected in 1902, which carried no load and was made of 1:2:4 mixture of cement, sand and trap rock. The examination showed a disintegration to such an extent that the surface was practically mush. Since that time examinations have disclosed still further serious deterioration and a voltmeter test showed that current under 11 volts pressure was passing through this structure. It was believed at the time of the second examination that the "failure" was due to the action of salt water alone, and no test was made for stray electrical currents until lately.

This is not an isolated case. There is an exact duplicate in almost every particular, except that the latter structure was erected a year later and different brands of cement were used. In the summer of 1911 the writer made an inspection of some concrete tunnels and bridges on which work has been only recently finished. In all this work the different brands of cement used were rigidly tested. The structures are all above tide level, and wet only in spots. Where the concrete is wet, from one to five volts was found, and the concrete is deteriorating, though not as much as in the former instances. Where the concrete is dry no voltage was found and the concrete is in excellent shape; this occurs in the same tunnel, the concrete apparently being the same mixture and placed at the same time. It seems to make no difference whether the concrete was placed in cold or warm weather, deterioration goes on just the same, the only difference being between the wet and dry places.

It is a known fact that, although wet concrete is an excellent conductor, dry concrete is practically a non-conductor. The combination of electric current and water seems to act as a disintegrating agent on the cement, destroying its cohesion and reducing it to a paste, which when dried can be pulverized with the fingers. This condition demands immediate remedial measures, or serious trouble will undoubtedly ensue.

One efficient means of preventing the damage may be mentioned, however: waterproofing thoroughly all parts of a concrete structure that is surrounded by earth. Such protection acts in two ways; it keeps the structure dry and it insulates against electric currents.

MARION STEAM SHOVELS.

The St. Louis Portland Cement Company, St. Louis, Mo., are using a Model 100 Marion shovel for loading the stone into the quarry cars. This improved shovel, which is especially adapted for cement plants, is manufactured by the Marion Steam Shovel Company, Marion, Ohio.

The Choctaw Portland Cement Company, Hartshorne, Okla., also employ a Marion steam shovel for loading rock into 6-yard cars, whence it is delivered to crushing plant.

The Pebble Beaches of Lake Superior

An important factor in the manufacture of Portland cement is the means of fine-grinding, which can be economically performed only by tube mills and grinding pebbles. The source of these pebbles has formerly been confined to the northern coasts of France, Belgium and Denmark, and it has been a question of how long this source would supply the enormous demand.

We have grounds to believe that worry over this problem should cease, as a source of supply near the home market has been discovered within the last few years. The latter is located along the North shore of Lake Superior, and we consider the results of our investigations to be of extreme interest to cement manufacturers.

Although the Lake Superior North Shore coast is removed only by a large body of fresh water from the northern boundary line of the State of Michigan, little information generally of that coast or the interior country to the north, is possessed by the individual in the United States, or for that matter by the average citizen of Canada. This is no doubt due to the scant population of the district and lack of general interest attached to it in the past. Probably on that account and because the country to the north has been lost sight of in the rush to the Western Prairies, though many natural harbors exist, there are few organized ports between Sault Ste. Marie on the east to Port Arthur on the west.

The Canadian Pacific Ry. traverses the shore line for nearly two hundred miles easterly from Port Arthur, but few travelers have seen any inducements to stop off and investigate conditions along the route or in the great forest region to the north. The transcontinental traveler, who after looking upon a few miles of continuous rocks and lonely forest, exclaims, "What a desolate country; how soon will we be out of it?" does not make an original remark, by any means. He has not, however, been trained to appreciate a kind of wonderful scenery which is new to him.

Of recent years Canada has become a haunt of geologists. We understand that rocks of every age of the earth's history are to be found somewhere in that country. The original protuberance of what is now the North American continent, can be traced out within the boundaries of Canada. It is recognizable by the Igneus (heat formed) rocks of the pre-Cambrian period—the first rock period of the earth. This area is U-shaped, the Hudson Bay making the center of the U. The western boundary is made by the McKenzie River flowing from Great Slave Lake north into the Arctic Ocean; the eastern by the Atlantic Ocean and the southern, generally speaking, by the St. Lawrence River and the Great Lakes. Most of this great U-shaped area has been scourged by the slowly moving mountains of ice in the Glacial period. Consequently, although the extensive clay belt of Northern Ontario lies in this area, the depth of soil is not generally great, and the latter fact is particularly in evidence along the north shore of Lake Superior.

The coast of Lake Superior is rocky and generally abrupt. Trees, however, are numerous and are even to be seen growing out of crevices in the rocks, with apparently no soil to give them sustenance. Back from the coast the soil is usually several feet in depth, and the country is heavily wooded.

From a mineral standpoint, the geology is favorable to the chances of a prospector finding gold. Many prospectors have traveled the district, and after making enticing "finds" have staked their claims. However, the rocks have proved too tough and hard for the usually limited financial resources of the prospectors, and he has gone to districts where the "pay stuff" is more easily mined.

Present stock of the Canada Pebble Company, at their Jackfish beach. A locomotive crane is employed for handling the pebbles.

The north shore of Lake Superior is often beaten by terrific seas. The broken rocks dropped into the lake by the mechanical agencies of nature have been washed back and forward for thousands of years, until they have been worn in to spherical and egg-shaped pebbles, varying in size from one to ten inches in diameter. These pebbles are washed up by the high waves into beaches which stretch along the shore line several feet above the normal level of the lake. The beaches, however, show only a small proportion of the actual pebbles. They are but the exposed fringe of a body of pebbles submerged along the shore line and which can be traced at times for half a mile out from the shore. Investigation has proven that the depth of pebbles increases as the distance from the shore line increases, consequently as the latter are washed in by the waves the widths of the beaches are constantly increased. Evidence of the movement of these great bodies of pebbles is exemplified at the Jack Fish Beach, in the lateral movement of piles which were driven at one time to support a wharf.

The beaches occur at frequent intervals along the coast, for over 250 miles. The individual beaches vary from a quarter to several miles in length. A feature to be seen at some of these is the result of the mechanical assorting by the waves of the pebbles into sizes which are graded from the largest at one end to the smallest size at the other end of the beach.

Until several years ago these pebbles were passed over as being of no commercial value. They were too smooth and lacking in angularity to be of value in concrete or building work, and too hard and tough to be broken for that purpose.

About three years ago a couple of men were exploring the "north shore." One of these men was John Lind, a mining man of a long, varied and unusual experience. He saw with eyes that realized the value of pebbles. The Canada Pebble Company Limited of Port Arthur is the result. Camps and a plant were installed and operations commenced. The industry has had a remarkable growth and from the present outlook that growth will continue.

In producing the pebbles this company use a locomotive crane for handling the bulk pebbles from the beach to the hopper of a screen. The pebbles are assorted into standard sizes by screening and are then hand-picked and placed in bags. A large stock is kept at the beach ready for direct shipment to the consumer by rail, or for transportation by water to several ports on the Great Lakes which are kept constantly stocked.

An unlimited source of supply of grinding pebbles is claimed for the district we speak of and lying so near the market should revolutionize the pebble industry in America.

Loading Vessel at Dock. Canada Pebble Company.

CANADIAN CEMENT PRODUCTION.

Complete statistics have been received from the manufacturers of cement covering their production and shipments during the year 1911. These returns show that the total quantity of cement made during the year, including both Portland and slag cement, was 5,677,539 barrels, as compared with 4,396,282 barrels in 1910, an increase of 1,281,257 barrels, or 20 per cent. The total quantity of Canadian Portland cement sold during the year was 5,636,950 barrels, as compared with 4,753,975 barrels in 1910, an increase of 881,975 barrels, or 18.5 per cent.

For a quarter of a century the general offices and Chicago laboratories of Robert W. Hunt & Co. have been in the Rookery building. Owing to the inability to secure in that building the necessary space in which to conduct their very largely increased business they will move December 1st to the twenty-second floor of the Insurance Exchange building, where they will have ample space for their offices and both chemical and cement laboratories.

NEW BOOK.

"Walls, Bins and Grain Elevators," second edition, fully revised, 556 pp., $4.00 (17s) net, postpaid. Design and construction and a systematic analysis of stresses due to granular materials. The new chapters on "Reinforced Concrete" and "Methods of Construction and Cost of Retaining Walls" are especially valuable. Published by McGraw-Hill Co. and supplied by Cement & Engineering News, Schiller Bldg., Chicago.

HIGHWAY ENGINEERS' HANDBOOK.

The new book just issued, entitled "Highway Engineers' Handbook," by Wilson G. Harger, C. E. and Edmund A. Bonney, is a pocketbook for the field and office man, that gives useful reference data on all phases of road construction and maintenance.

It contains a whole library of essential facts, carefully classified, indexed, and condensed into a flexible, compact, leather pocketbook, 4⅛"x6⅞"⅝". There is more material in the 500 pages of this book, the publishers declare, than in the usual 6x9" (8vo) treatise of 1,000 pages.

The authors, who have had a practical training in the New York State Department of Highways, have been assisted by leading road engineers and manufacturers in securing material that is up to date and reliable.

Special Features of the Book.

A great variety of special tables and general mathematical tables.

An unusually complete set of curve tables requiring no interpolation.

Tables of quantities of materials—cement, sand, stone, binder, filler, etc., for macadam, concrete, brick and other kinds of roads.

Full and complete cost data for estimating all classes of roadwork.

Specifications for all classes of work and material employed.

Full details of construction.

Tables of earthwork, macadam, concrete, reinforcement, oils, etc. These are time-savers to the officeman.

The survey—details, suggestions, tables, examples, mapping, etc.

Headings of the Main Divisions.

PART I.—THEORY OF DESIGN—A PRACTICAL TEXTBOOK, 115 PAGES.

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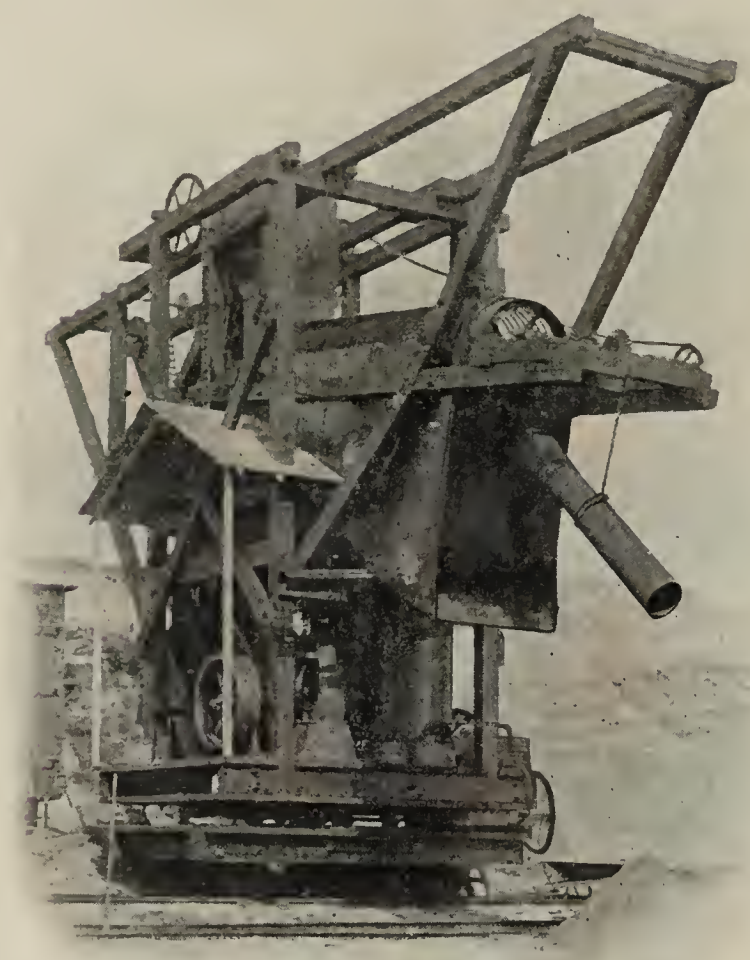
Flexible leather, full gilt. Price $3.00. Sent on receipt of price by Cement & Engineering News, Schiller Bldg., Chicago.

AUTOMATIC SAND AND GRAVEL ELEVATORS.

When such material as sand and gravel can be sold as low as 20 cents a ton, and yet the net profit on the material handled pays for the handling machine in less than six months, this is proof positive of the wonderful efficiency and economy of the handling machinery. And this is the record, in numerous instances, made by the "Improved Automatic" Sand and Gravel Elevator shown below, says the manufacturer.

In the handling of screened sand and gravel for concrete work, brickwork, or plastering, or in loading gravel for railroad work, this machine, it is claimed, practically eliminates competition, as there is no other appliance manufactured that can elevate, screen, and load material into cars so cheaply.

For loading run-of-bank gravel for ballast in railroad work, a special machine is made without the



Improved Automatic Sand and Gravel Elevator.

screening device. It is furnished with 3-foot buckets, and will load from 1,500 to 2,000 cubic yards of gravel per day, but five men being required for its operation. This machine is so constructed that it requires no spotting engine and crew to handle the cars, as it is propelled by its own power, loading cars at any point on a parallel track. It does its own excavating, and may be operated from either side or end. This elevating and loading machine is supplied with three strands of heavy chain to which are attached continuously, the special designed, flanged steel buckets provided with digging teeth, the whole being mounted on a steel frame controlled by a drum, which permits it to be hoisted out into the gravel bank, where it cuts its way in sufficiently to fill each bucket in turn, producing a continuous stream of gravel in the car. One man controls this operation with a lever working on the drum. Where large quantities of unscreened gravel are being used for ballast, there is no other device manufactured that will load it as cheaply as this machine. It is especially useful in case of wash-outs, on account of the brief time required to place it in operation.

Many railroad engineers are using the regular 24-in. bucket screening machines to furnish sand and gravel for their concrete work, thereby saving a large percentage on the cost of that class of work. The same machine is used for loading ballast when material for concreting is not needed. The screening machine can be changed from the operation of screening sand and gravel to loading run-of-bank in five minutes' time.

One of the Standard 24-inch Bucket Machines in operation is shown in the cut appearing on page 67. The twelve cars—six of sand and six of gravel, on parallel tracks—were screened and loaded in five hours, only six men being required for the work. This machine screens the sand and gravel, loads the sand in one car and the gravel in another, traveling by its own power along the track, and requiring the services of a locomotive only when all empties are loaded and a new supply needed.

The screening device, which will handle the largest tonnage of any screen made, screening the material ready for the market, is of very interesting construction. It consists of a large cylinder, 4 feet in diameter and 12 feet long, with longitudinal wire rods passing through drilled holes in wrought-iron rings which are placed every four inches, the rings being held in place by four angle-bars to which they are bolted, and which, as they pass around, also serve the purpose of lifting the material and throwing it from one side of the screen to the other, by which process it is forced through the mesh.

The company make the liberal offer to anyone interested in handling sand and gravel, of paying the entire expense of a visit of inspection to one of their machines in operation, if the machine should be found different from what it is represented.

PULVERIZED LIMESTONE.

At the present time there is a great demand for a pulverizer that will grind limestone to necessary fineness that can be operated by the ordinary intelligent workmen, writes the Bradley Pulverizer Company, Boston, Mass. Our Bradley Three Roll mill is especially adapted to this work, being simple in construction, economical in upkeep with but few wearing parts. The demand for pulverized limestone for agricultural purposes is getting to be quite an industry. We have just sold one machine to parties in New York state who had a considerable quantity of limestone. They advise us that mill is working fine doing all they require of it and are selling their product around $3.00 per ton. Tests show that pulverized limestone is very beneficial to the soil and is superior to commercial or lump lime and much cheaper. For the man with small capital and a little limestone this opens up a proposition that should be a big money maker.

All that is really required is a few bins, a pot crusher, Bradley Three Roll Mill, a few elevators and motive power.

Fineness is an important point in the grinding of this material and the necessary fineness should be procured without the use of auxiliary screens. Ours is the only moderate priced grinder that will give a large output with necessary fineness in one operation, as it is entirely self contained requiring no auxiliary screens. This is a very important point with the small producer. In order to make a success of this business he must procure simplest machinery he can obtain.

This business is a sure winner. It is thought by many that it requires a great amount of machinery. This is not true and we will give any interested party full data on this subject and estimate about what it would cost to erect a plant for this purpose.

Let this Machine Make the Sale

By the Quality and Quantity of Drain Tile it will turn out right in *your own plant*

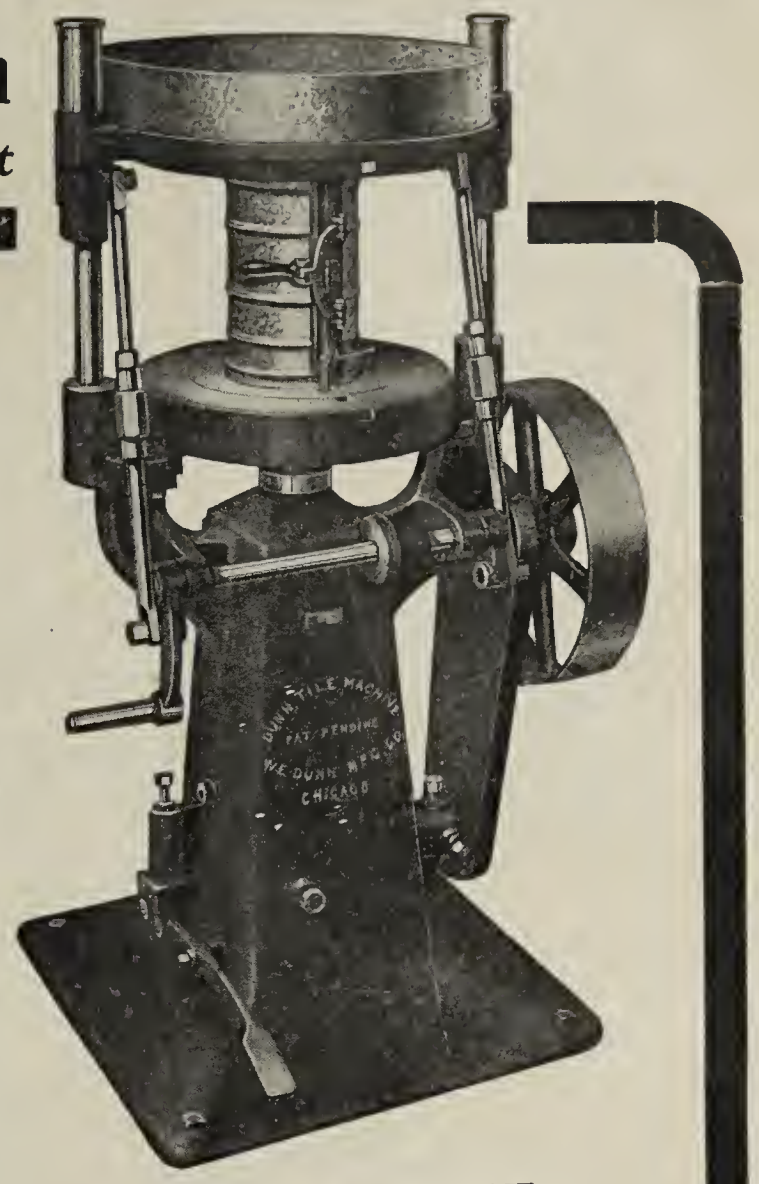
We'll ship the machine this way: You take it out from the crate, set it up and operate it from printed instructions. Make tile on it for two weeks.

Test it out thoroughly and if it isn't satisfactory or as represented, then ship it back at our expense.

Dunn Tile Machine is built on the only correct principle. Broad, solid base—cast in one piece. Journals are provided with bronze bushings. All the simple machinery is enclosed in the dust-proof case. It makes all sizes of tile from 3 to 12 inches. Capacity, 2000 tile per day.

The cement tile business has a big future, and will produce from 30 to 100 per cent profit, so that you owe it to yourself to at least investigate this business.

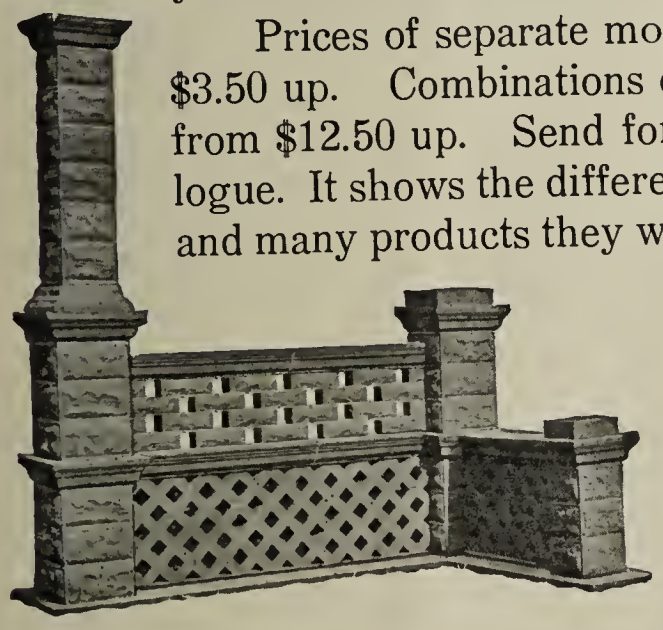
We have a catalogue which contains a good deal of information about this business and about this machine. Send for one. It's free.



PRICE, $175

Ornamental Porch Molds

We make a full line of ornamental molds for making porches, posts, piers, chimneys, etc. The molds are sold separately or in combinations at prices that will astonish you.



Prices of separate molds from $3.50 up. Combinations of molds from $12.50 up. Send for a catalogue. It shows the different molds and many products they will make.

Poured Sewer Pipe Molds

No tamping required. Mix the concrete wet and pour it into the molds. The result is a firm, dense pipe that will stand the severest tests, which is very important when the pipe are to be used for sewers, irrigation and road culverts.

In case you wish to make dry tamped pipe, you can do so. The stability of our core form and the positive locking device insures a product of uniform thickness.

Send for a catalogue. It describes these molds and the poured system fully.

W. E. DUNN MFG. CO.

4139 Fillmore Street
CHICAGO

STEEL FORMS FOR CONSTRUCTING CONCRETE SIDEWALK, CURB AND GUTTER.

No type of concrete construction is better adapted for the use of steel forms than concrete sidewalk, curb and combined curb and gutter. Although steel forms are more expensive than wood in first cost, their advantages are so many that they are now being used to a large extent in work of this sort. One of the more interesting designs of steel forms now on the market is that of the Hotchkiss Lock Metal Form Co., of Binghamton, N. Y. This form consists of rigid or flexible side rails, division plates and wedge-shaped keys or lugs for fastening these parts together. The division plate holds the side pieces in place, thus making the forms self-sustaining and self-bracing. The rigid sides are commonly 10 ft. long and have slots at 1-ft. intervals to receive the division plates. They have a flange at top and bottom to keep them rigid and in use are joined end to end by a tongue and socket. These rails are also made in 4-ft. and 6-ft. lengths. The flexible side rails have no flanges. They are made of spring steel and may be bent to any desired curve.

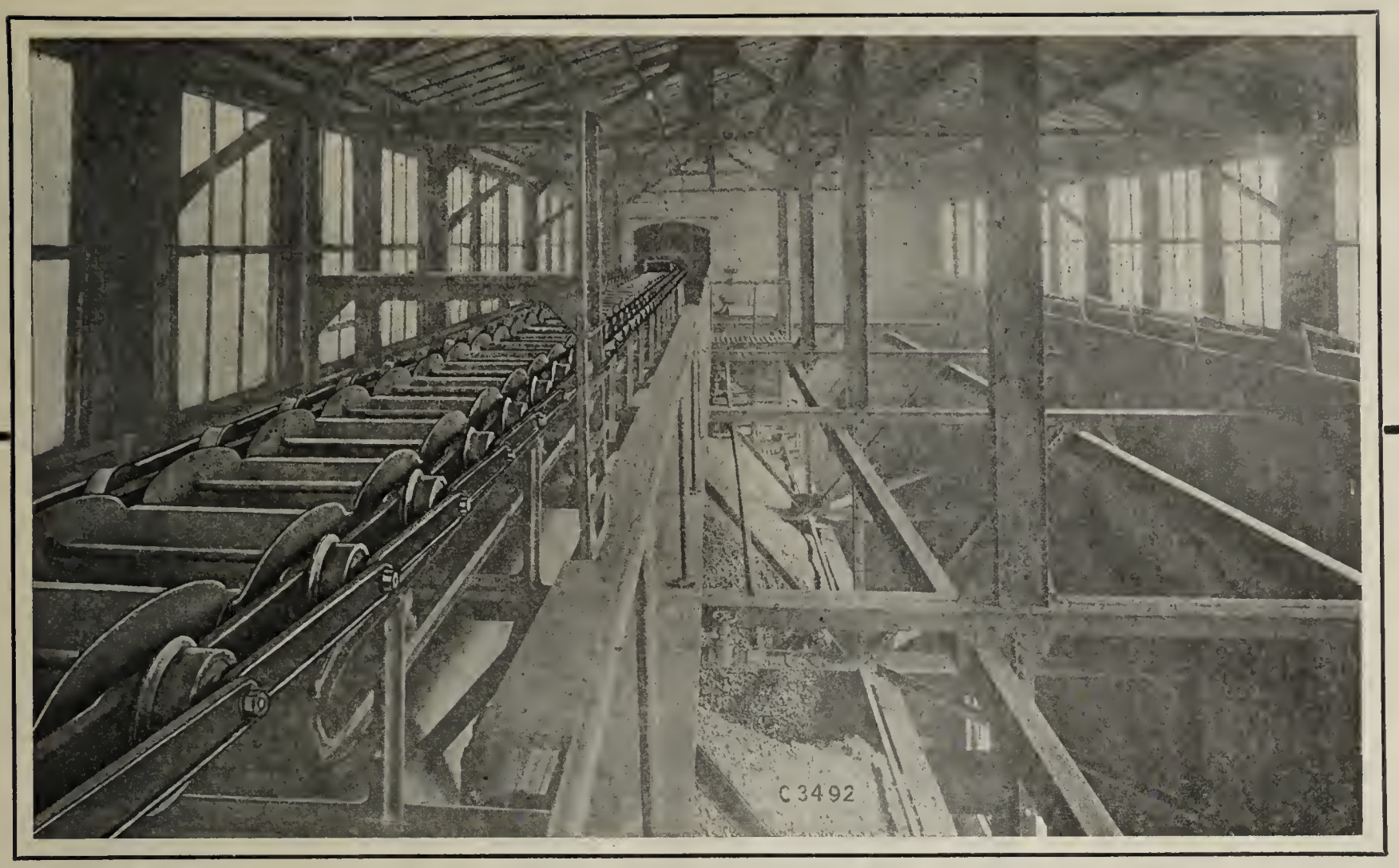
The recommended method of constructing sidewalks with these forms is about as follows: At least 50 ft. of the forms are connected up in place, and the concrete placed in the first block. The grader starts at work leveling the concrete so that after it is tamped it will come within ½ in. or 1 in. of the top of the forms. Behind the grader follows the tamper, tamping the whole concrete surface firmly, taking pains to tamp next to the side-rails and the division plates. The concrete should have been mixed middling stiff. While this work is being done another part of the gang should have been mixing the top. This, too, should be mixed middling stiff, with just enough water so that when it is tamped firmly into the concrete base there will be enough moisture come to the top to finish nicely. Here is another tamper at work on the top. Following him are two men striking off, and close on the strike-off is the finisher floating and edging, which is also done immediately without any waiting for a puddled surface to dry out. Immediately after the walk is edged, the keys are knocked out of the side-rails, and the rails passed on to the front, the plates removed and the points grooved.

The Hotchkiss Co. also manufactures a steel curb and gutter form. (Write Dept. O, Binghamton, N. Y., for circular.) This consists of steel templates which conform in shape to the finished curb and gutter. To serve as molds for the back of the curb and front of the gutter are provided steel channels, which are slotted at regular intervals. On the front and back of the template are tongues which pass through these slots and are locked there by lugs on the outside. When set up this way they form a rigid and substantial form that will stand alone and which does not need any stakes or braces. The cut shows a section of curb in course of construction with these forms. The illustration shows a portion of the completed curb, the forms in position on another portion, and the division piece in process of removal.

View of Concrete Curb in Course of Construction with Hotchkiss Metal Forms.

SAND-LIME BRICK.

The Canada Brick Company, of Montreal, Que., has placed an order for one of the American Clay Machinery Company's 16-mold rotary sand-lime brick presses. The Canada Brick Company is equipping its plant throughout for the making of a high-grade sand-lime brick, and the result of the operation of this plant no doubt will more than please the architects and builders of Montreal, as the materials used are of the highest grade and the work there is being handled by some of the most competent engineers in the country. R. Brutinel is director of the company and under his excellent management it will be placed among the best operating plants in Canada.



Peck Carrier Handling Coal Over Bunkers in Power House

Are Your Coal-Handling Costs too High?

Did you ever consider how much it costs to handle coal and ashes in your power house?

Do you realize, Mr. Manufacturer, that this department is very frequently overlooked, even in manufacturing establishments employing the most modern methods in their other departments?

The Peck Carrier—an overlapping pivoted bucket conveyor—is in successful operation in hundreds of power houses today, handling both coal and ashes. It is smooth-running, non-spilling, requires less power than any similar type on the market today, and experience shows cost of repairs to be almost negligible. It is the recognized standard method of handling coal and ashes in the modern power house.

If you are interested in cutting down the cost of handling your coal and ashes, let us tell you just what the Peck Carrier will do for you. Hundreds of testimonials from satisfied customers cover almost every point that it is possible to raise—proof of its unequaled success.

The Peck Carrier is also extensively used for handling hot and cold clinker in cement mills, as well as for sand, gravel, crushed rock, ore, etc.

Our Peck Carrier Book No. 81 explains the design and construction fully, and shows its superiority over all other types. Every factory manager should have a copy. Address nearest office.

LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

New York	299 Broadway	Seattle	512½ First Ave., S.
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St. Louis	Central Nat'l Bank Bldg.	New Orleans	Wilmot Machinery Co.
Buffalo	596 Ellicott Square	Los Angeles	Security Bldg.
Birmingham	General Mchy. Co.	Minneapolis	Link-Belt Supply Co.

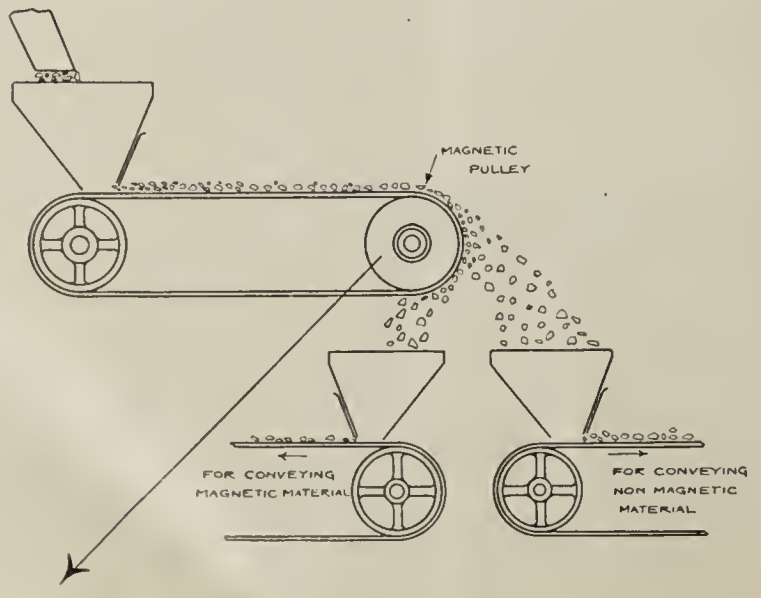
THE MAGNETIC SEPARATOR IN THE CEMENT PLANT.

The Southwestern Portland Cement Company, El Paso, Texas, has recently installed a special type of magnetic separator in its plant for removing stray iron and other magnetic materials. This separator, built by the Cutler-Hammer Clutch Company of Milwaukee, differs somewhat from types installed in several other plants during the past year. An I-beam frame is used on which is mounted the magnetic pulley, right end, the wooden tail pulley at the other, and two idler pulleys between. This construction was used in this case because of the heavy weight of the material conveyed to the belt. The mixture on which the separation is to be effected is fed by a suitable hopper onto the conveyor belt, by means of which it is passed over the pulley. The magnetic material is drawn strongly toward the face of the pulley, and this hugs the belt closely up to the point at which the belt leaves the pulley at the lower side. At this point it is snapped off by the belt, and falls into a chute or other arrangement for conveying it away. The non-magnetic material is projected some distance in front of the pulley, thus being widely removed from the magnetic material and making a very clean separation.

The magnetic pulley consists of alternate coils and steel discs concentric with the shaft, the former being wound on steel spools doweled to the discs, which are in turn keyed to the shaft. Each coil is enclosed and protected by a cylindrical brass coil shield, having a tight fit on each of the two adjacent poles. Current for the coils is obtained through carbon brushes held on a pair of slip rings, by self-adjusting holders.

These pulleys are regularly built 12 inches in diameter, in lengths from 16 inches to 36 inches, having a current consumption of 325 to 750 watts, and capacities of 1,340 to 3,000 cubic feet per hour. Standard pulleys are designed to operate on any direct current voltage up to 250.

Motor Driven Magnetic Separator.



BOOK REVIEWS.

The Hill Book Company has recently published a volume entitled "Reinforced Concrete Buildings," of which Ernest L. Ransome and Alexis Saurbrey are joint authors.

The authors say in the preface that the volume is presented to the engineering profession for the purpose of showing what reinforced concrete is, and how it came to be what it is, and they have endeavored to select matters of interest to the mature and experienced engineer, and for that reason the ultimate result of the analysis has been treated in greater detail than the derivation. In other words, it is not a text book, but a book for the practical man.

Mr. Ransome writes the first chapter, which is devoted entirely to personal reminiscence, especially with regard to his own inventions in the field of reinforced concrete.

Mr. Saurbrey writes the second chapter and devotes it to basic patents and a short survey of the early history of the art. This part also includes sections entitled "The Period of Discovery," "The Period of Improvement," and "Recent Patents."

Part II of the book is also by Mr. Saurbrey, under the general title of "Rational Designs of Reinforced Concrete Buildings," while Part III takes up the matter of practical construction and is by both the authors.

The book comprises 232 pages, with 176 illustrations, and the price is $2.50. It can be supplied by Cement & Engineering News, Schiller Bldg., Chicago.

Avoid Expensive Breakdowns
and Repair Bills
by Using Dependable Chains

Jeffrey "Hercules" Malleable and Steel Combination Detachable Chain

is designed especially for extra heavy work in handling Gritty Material in Cement Plants, Chemical Works, Mines, etc. Also extensively used for general Elevating and Conveying Work. Practically Dust Proof. Works upon standard sprocket wheels.

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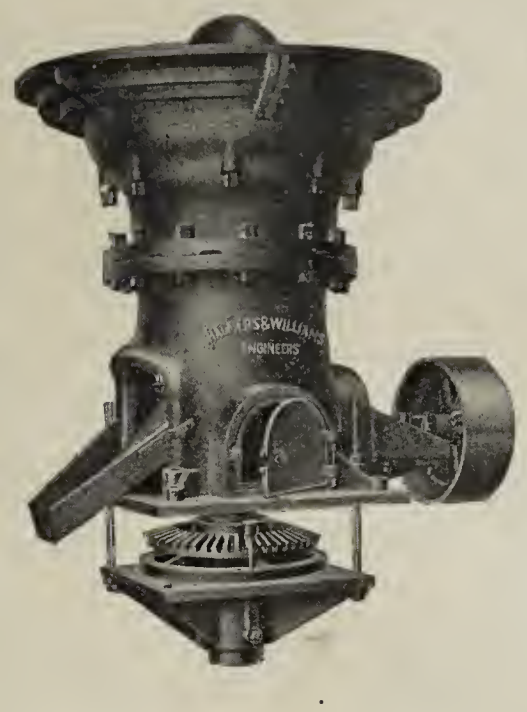

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It has been experimented on, developed and perfected by us. It will reduce the cost of your crushed product, by reducing the amount of power consumed, by the low cost for repairs and by the increased capacity.

You cannot afford to let this opportunity go by.

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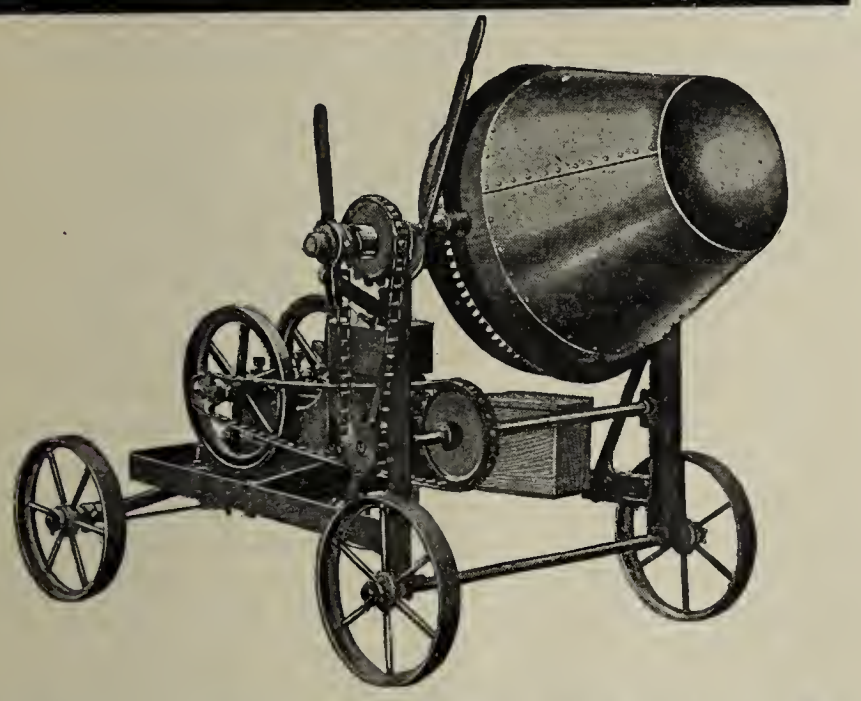

THE HELPER MIXER

A real, genuine, thoroughbred work-saver and money-maker; a tilting batch mixer which is a real helper to the man who takes the small jobs and an able assistant to the man who takes the big contracts.

10 DAYS' FREE TRIAL

Get Our Proposition

The Cement Tile Machinery Company
41 Rath Street **WATERLOO, IOWA**

History—Not Theory

The Novo Engine is operating thousands of cement machines of all makes and kinds. It has been adopted because of the unusual combination of lightness, lack of lateral vibration, and general high efficiency, which makes the

NOVO ENGINE

peculiarly and ideally adapted to the running of cement machinery. It is the lightest engine for power developed and is so simple that a trained operator is not required.

See the Novo at the Cement Shows

At Pittsburgh, spaces Nos. 3, 4 and 5.

At Chicago, space No. 172.

Write for Novo Catalog

and examine into the features of this engine. You will see how profitable it can become in your business.

"The Engine for Every Purpose"

NOVO ENGINE CO.
CLARENCE E. BEMENT
Sec'y and Gen'l Mgr.
219 Willow St., Lansing, Mich.

THE BIRN CONCRETE BLOCK PRESS.

For centuries the use of natural stone has been given the highest place in the construction of buildings both by architects and builders, yet many natural stones have inherent faults, some of which show themselves early and others only appear with the lapse of time. Stones of sedimentary origin, unless carefully laid on their natural beds, will flake off and become greatly weakened; other stones, especially the granites, are particularly susceptible to fire, a comparatively slight heat ruining the largest blocks.

The difficulty of procuring blocks of suitable size of various stones led to the introduction of burnt clay products, such as tile and terra-cotta, but these, too, have their limitations in cost and availability.

The introduction of American Portland Cement has led to the commercial use of concrete in many forms, no one of which is of greater value than that of concrete blocks. The blocks, as made by the best machines, are really artificial stone, being composed of the same materials and having the same chemical and structural composition.

A great many machines have been designed for the manufacture of blocks; most of these are mere forms in which the block is tamped, the machine merely facilitating the process of manufacture.

In the Birn Concrete Block Press a rather different system is employed. The block as patented is of an "L" shape, with the broad face exposed to the weather.

This face is on the top when in the machine and great pressure is brought to bear upon it so that the material is compressed into a firm homogeneous block, non-porous and permanent.

The Birn Concrete Block Press is manufactured by the Northwestern Steel & Iron Works, 1080 Spring street, Eau Claire, Wis. In the catalogue which they are sending out are many interesting ideas to the block manufacturer. The catalogue shows in great detail the method of making block and laying them in the wall to produce the best results. This catalogue is of interest to every concrete worker and will be mailed to you upon request if you mention Cement & Engineering News.

AN OPEN LETTER TO THE DEALER.

Generally speaking, most dealers in Portland Cements were unable to promptly secure their requirements this season, writes the sales department of the Chicago Portland Cement Company.

While we regret that the severe car shortage was a big handicap to our service, we believe that our obligations were well taken care of.

We feel, however, that a plain statement, bearing on our attitude during that period, and that our thanks are also due our customers, for their consideration of us, when conditions, over which we had no control, made it difficult for us to render them the same prompt service to which they are ordinarily accustomed.

July 25th we anticipated the condition as it developed and in our letter of that date we urged our customers to load their warehouses to the fullest capacity.

August 31st when the shortage was acute, when the number of cars being furnished us was wholly inadequate, we urged our customers not to oversell their stock of "CHICAGO AA" on hand, and to avoid quoting prices on new business without first communicating with us.

We were then practically two days behind in our shipments and discontinued until October 15th quoting other than our regular customers. In brief, we have done everything possible under extremely adverse conditions to render our customers the same reliable service to which they are accustomed.

Orders were shipped as near the date listed as conditions would permit, whether the price was high or low. This principle was strictly observed.

1913 EDITION CEMENT DIRECTORY.

We are advised by the Bradley Pulverizer Company, Boston, Mass., that they will soon go to press on their new 1913 edition of The American Cement Directory, which is now published by the Bradley Company and sent free of charge to the managers, superintendents, chemists and purchasing agents of the cement plants. This directory for the past three years was published by the Technical Press and sold by them at $1.00 per copy. It is quite costly to publish as it is well bound in a flexible genuine leather cover and gotten up in a superior manner. A few pages of advertising space will be sold to help pay cost of publishing. Single pages $25.00.

MARQUETTE STONE COMPANY.

The crusher plant of the Marquette Stone company at Marquette, Mich., is now in operation with a large force of men manufacturing the crushed rock for the new dock at Presque Isle. Fifty men were employed at the crusher last year, and it is expected the force will be increased to that number in a short time.

The equipment consists of five motors, three crushers and a 150 h. p. air compressor, the power for which is supplied by the city. There were 35,000 tons of rock crushed last year, most of which went to the construction of the Lake Superior & Ishpeming railroad's ore dock at Presque Isle. Some rock was shipped to Detroit and other lower Michigan cities, and some was used in the building of the road to Ishpeming.

Many inquiries for the rock have been received this year from outside cities because of the fact that it is especially adapted to road building. Its cost is double that of limestone, but it has a cementing quality that acts as a bind for the road bed, it lasts longer, and it raises no dust. Two kinds of stone are taken from the hills at Marquette, one variety being especially adapted to reinforced concrete structures because of the fact that it is fire proof, whereas limestone is not.

There is a possibility that the organization of another company at the Soo will take away the lake ports trade of the Marquette Stone company and the Lipsett & Sinclair company, which has a crusher plant beyond the hospital, but which has not yet begun operation. This company would crush the rock in the stock piles at Bruce's mines of Canada east of the Soo. This trap rock formation is an extension of the Marquette county supply, and the fact that the ore can be loaded from the crusher into the boats by gravity makes it possible to reduce the manufacturing cost to such an extent that the Marquette county companies would be unable to compete. Definite steps in this direction, however, have not been taken as yet. The organization of a company for this purpose would not injure the companies to any extent because of the fact that shipping by boat has been found impractical, and in shipping to a city not a lake port the cost would be the same because of the added cost of reloading from the boats. The rock crushing industry in Marquette will have a successful season, it is expected.

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